ELECTRICAL REVIEW

ILLUSTRATED.

A WEEKLY JOURNAL OF

Electric Light, Power, Telephone, Telegraph and Scientific Progress.

VOL. 19, No. 10. WEEKLY.

NEW YORK, SATURDAY, OCTOBER 31, 1891.

$3 per Annum. Single Copies, 10 Cents.

Copyright, 1891, by ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

VIEWS, NEWS AND INTERVIEWS.

"If the coal business increases next year in the same proportion it has this year," said a prominent Pittsburgh coal man, "the miners will ask us for an advance in wages. This will force us to adopt some other means of mining our coal. If electric coal cutters can do the work satisfactorily, they are what we want."

Keith, of theatrical fame, uses for advertising purposes, in Philadelphia, a wagon carrying a storage battery plant which runs a large number of incandescent lamps. The lights cover the wagon, forming signs and designs.

It happened in Chicago. He suggested to a city official that it was a shame that Chicago's streets could not be properly lighted.

"Why, they are," protested the city official. "There are both electric lights and gas. What more do you want?"

"I want one or the other used," said the citizen. "The other morning when I was going home every light had been put out."

"Oh, well," asserted the official, "the sun was up then."

"No, it wasn't," retorted the citizen. "There wasn't even a glimmer of it. It was dark as pitch."

"That's funny," commented the official. "We're very particular about the hour those lights are put out."

"Funny!" exclaimed the citizen. "It's an outrage!"

"Yes, it is," admitted the official. "The sun ought to be up by the time those lights are put out. I wonder what's the matter with the sun."

The Edison General Electric Company will erect an elegant building in Pittsburgh at the corner of Wood and Diamond streets, the site of the building formerly occupied by the Weldin Book Company. The building will be 30x80 feet and thoroughly equipped for business.

The street railway current which supplied the Ward arc lamps on the exhibition boat at Pittsburgh varied from 350 to 500 volts. The changes were often very abrupt, but they were only evident from an inspection of the voltmeter; the lamps burned steadily.

Is there any valid reason why a man attending an electrical or street railway convention should pay $20 a day for a $5 room, or $12 a day for a $3 room? It seems that at convention times hotel proprietors delight in assuming all the most distinguishing characteristics of the highway robber. It would be a relief to discover a hotel proprietor who could maintain his moral balance in a season of unusual prosperity.

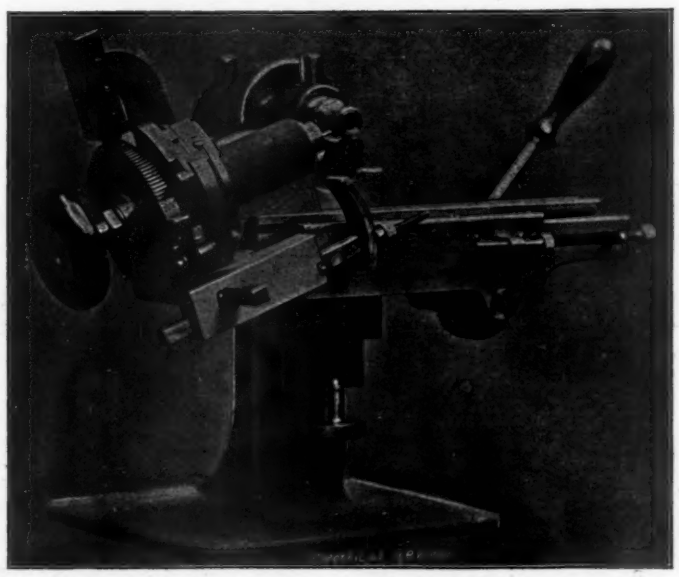
Captain de Khotinsky, an electrical inventor of European fame, has connected himself with the Germania Electric Company, of Boston, which controls the Khotinsky patents for this country.

A new typesetting machine, operated by electricity, has been invented by a compositor at Muskegon, Mich.

The Dwight Slate Machine Company's New Semi-Automatic Pinion or Gear Cutter.

The making of special machines for expediting work and the introducing, as far as possible, automatic devices for insuring accuracy, rapidity and the saving of labor, the uniting or combining of different processes in the same machine, and the perfecting and adapting of patented machines or devices in their oft-times crude and valueless form, to the mechanical standard necessary to their profitable and successful use has, during the past 25 years, been a prominent and leading portion of the business of Mr. Dwight Slate, the head of the Dwight Slate Machine Company, of Hartford, Conn.

This company has recently put upon the market a semi-automatic pinion or gear cutter, shown in the accompanying illustration. It is specially adapted to cutting straight and beveled pinions and light gear cutting.



THE DWIGHT SLATE MACHINE COMPANY'S NEW SEMI-AUTOMATIC PINION OR GEAR CUTTER.

This machine operates similarly to a hand miller, but suitable mechanism is connected with the index, so that with the return of the table the index is worked automatically.

The machine illustrated is of a new design, having a swinging head. It is made for milling steel burrs for dentist's use, and is also adapted for small pinion or gear cutting, from seven teeth up.

Electrical manufacturing companies are frequently in need of just such machines when they can depend upon their being exact and true cutters.

The New Lighting Station in Boston.

The progress in electricity is shown by the increase in power which the Edison Electric Illuminating Company, of Boston, have just put in. They have now 33 Armington & Sims' engines of 150 horse-power each, with the necessary boiler capacity, comprising Babcock & Wilcox, Heine and tubular. The greater portion of these boilers are set with the Jarvis patent setting; they also use a shaking grate, which is known as the Sheffield shaking grate, manufactured by the Jarvis Engineering Company, in fact, this last change, which involved thousands of dollars, was installed by the Jarvis Engineering Company, whose reputation for doing first-class work is known among all steam users.

The Jarvis Engineering Company, of Boston, are actively engaged in the enlargement of the steam plant in the central station of the Boston Electric Light Company. This company's steady increase of business has made it necessary that the largest possible amount of power be concentrated in the smallest floor space, and to meet these requirements the Armington & Sims' Engine Company have designed a new upright compound condensing engine which combines the highest efficiency and economy, and occupies but little room. The first installation is four of these engines, fitted with the most modern appliances for condensing, having cylinders 11½ and 18½ inches in diameter and 13 inch stroke, running at 330 revolutions per minute, and with an initial pressure of 135 pounds will develop 200 horse-power each.

Steam will be supplied from four new horizontal tubular boilers, specially constructed for the carrying of this high pressure, set with the well known Jarvis patent furnace and fitted with Sheffield grate bars, which insures the greatest economy in the combustion of fuel. The getting out of plans for this addition and the work of carrying them out has been entirely under the advice and supervision of the Jarvis Engineering Company, whose long experience with this class of work has made them thoroughly familiar with the best methods, and when completed it is expected that this portion of the plant will possess advantages that no others have attained.

AMERICAN STREET RAILWAY ASSOCIATION

Holds Its Tenth Annual Meeting.

ELECTRIC RAILWAYS DISCUSSED — CLEVELAND THE NEXT MEETING PLACE.

The tenth annual meeting of the American Street Railway Association was held in the ball room of the Monongahela House, Pittsburgh, Pa., October 21-23, 1891.

The proceedings of the Convention began at 10.30 A. M., on Wednesday. Mr. Henry M. Watson, of Buffalo, N. Y., president of the Association, presided. Mr. William J. Richardson, of Brooklyn, N. Y., the secretary, called the roll, and it was found that the following delegates were present:

Attleboro, Mass.—C. F. Guild, president, H. M. Bogarto, George W. Mansfield, directors, Attleboro, North Attleboro and Wrentham Street Railway Co.

Baltimore, Md.—William A. House, Jr., general manager, Baltimore Traction Co.

Birmingham, Conn.—H. Holton Wood, president, and B. W. Porter, superintendent, Derby Street Railway Co.

Bridgeport, Conn.—F. Hard, president, and T. B. Lasher, secretary and treasurer, Bridgeport Horse Railway Co.

Brockton, Mass.—Allston Burr, Brockton Street Railway Co.

Brooklyn, N. Y.—William Richardson, president, William J. Richardson, secretary, and John G. Jenkins, director, Atlantic Avenue Railroad Co.; John G. Jenkins, director, Broadway Railroad Co.; A. W. Dickie, superintendent, and M. G. Sterrett, electrical engineer, Brooklyn City Railroad Co.

Buffalo, N. Y.—Henry M. Watson, president, and H. H. Littell, vice-president and general manager, Buffalo Railway Co.

Camden, N. J.—William S. Scull, president, G. Genge Browning, treasurer, J. J. Burleigh, electrician, and Samuel J. Fenner, superintendent, Camden Horse Railroad Co.

Chicago, Ill.—D. J. Kennedy, president, and A. H. Quaid, superintendent, Cicero and Proviso Street Railway Co.; T. C. Penington, treasurer, Chicago City Railway Co.; Charles F. Nagel, superintendent, West Chicago Street Railroad Co.

Cincinnati, O.—H. H. Littell, president, and H. M. Littell, general manager, Cincinnati Inclined Plane Railway Co.; John Harris, superintendent, and George Bullock, director, Cincinnati Street Railway Co.; Henry Martin, president, Mt. Auburn Railway Co., and E. F. Abbott, president, and T. M. Jenkins, superintendent, Covington Street Railway Co.

Cleveland, O.—A. Everett, president, Charles W. Wason, vice-president, H. A. Everett, secretary and treasurer, and Edwin Duty, superintendent, East Cleveland Railroad Co.; M. A. Hanna, president, and J. B. Hanna, secretary, Woodland Avenue and West Side Street Railroad Co.; H. J. Davis, secretary and treasurer, Brooklyn Street Railway Co.; Charles Hathaway, president, Cleveland City Cable Railway Co.

Columbus, O.—A. D. Rogers, president, Columbus Consolidated Street Railway Co.

Covington, Ky.—George Bullock, vice-president, and T. M. Jenkins, superintendent, South Covington and Cincinnati Street Railway Co.

Dallas, Tex.—Dallas Consolidated Rail way Co.

Dayton, O.—C. B. Clegg, president, Oakwood Street Railway Co.

Des Moines, Iowa.—J. S. Polk, president, G. B. Hippee, secretary, Des Moines Street Railroad Co.

Denver, Colo.—C. K. Durbin, superintendent, Denver Tramway Co.

Detroit, Mich.—James H. Vhay, president, S. Schloss, vice-president, N. W. Goodwin, secretary, and E. S. Hineman, treasurer, Fort Wayne and Elmwood Railway

Co.; H. M. Campbell, attorney, and E. W. Cottrell, superintendent, of Detroit Citizens' Street Railway Co.

Dover, N. H.—William D. Sawyer, president, Henry W. Burgett, vice-president and treasurer, Union Street Railroad Co.

Duluth, Minn.—F. S. Wardell, general manager, Duluth Street Railway Co.

Erie, Pa.—John C. Brady, vice-president, and J. F. Pfetch, general manager, Erie Electric Motor Co.

Easton, Pa.—Henry A. Sage, president, Easton, S. E. and W. E. Passenger Railway Co.

Findlay, O.—George B. Kerper, president, and Charles Smith, superintendent, Findlay Street Railway Co.

Galveston, Tex.—W. H. Sinclair, president, Galveston City Railway Co.

Grand Rapids, Mich.—James R. Chapman, vice-president, and J. J. Odell, director, Consolidated Street Railway Co.

Hamilton, Ont.—B. E. Charlton, president, and T. B. Griffith, secretary, Hamilton Street Railway Co.

Hartford, Conn.—E. S. Goodrich, president, Hartford and W. Horse Railway Co.

Houston, Tex.—H. F. MacGregor, general manager, Houston City Street Railway Co.

Indianapolis, Ind.—W. S. Jewell, superintendent, Citizens' Street Railway.

Lexington, Ky.—C. H. Stoll, president, W. J. Loughridge, vice-president, R. H. Smith, superintendent, Passenger and Belt Railway Co.

London, Canada.—V. Cronyn, president, and Thomas H. Smallman, director, London Street Railway.

Louisville, Ky.—J. B. Speed, president, and T. J. Minary, general manager, Louisville Railway Co.

Manchester, N. H.—Charles Williams, president, Chas. H. Bartlett, treasurer, and N. H. Walker, superintendent, Manchester Street Railway Co.

Milwaukee, Wis.—Henry C. Paine, vice-president, Geo. S. Jones, director, Milwaukee Street Railway Co.

Minneapolis, Minn.—Thomas Lowry, president, Minneapolis Street Railway Co.

Nashville, Tenn.—United Electric Railway Co.

Newark, N. J.—Thomas C. Barr, president, John Akarman, superintendent, and C. J. Field, electrical engineer, Newark Passenger Railway Co., and C. Radel, superintendent, Newark and South Orange Railroad Co.

Newburyport, Mass.—Charles Odell, president, Thomas H. Johnson and B. W. Russell, directors, Newburyport and Amesbury Horse Railroad Co.; E. P. Shaw, Jr., general manager, Black Rock and Salisbury Railway.

New York, N. Y.—C. Densmore Wyman, vice-president, C. P., N. and E. R. R. Co.; L. H. McIntire, engineer and manager, Harlem Bridge, M. and F. Railway Co.; Wm. Richardson, acting vice-president, D. D., E. B. and B. R. R. Co.; Thomas H. McLean, secretary, Twenty-third Street R. R. Co.; A. D. Field, president, Forty-second Street and Grand Street Ferry Railway Co.; D. B. Hasbrouck, secretary, Houston and W. Pavonia Railway Co.; W. H. Delany, director, North and East River Railroad; Milton S. Masson, secretary, Central Crosstown Railway Co.

Lancaster, Pa.—John A. Coyle, president, and W. M. Franklin, director, Lancaster City Railway Co.

Lawrence, Mass.—N. E. Morton, superintendent, Merrimac V. H. Railway Co.

Lowell, Mass.—P. F. Sullivan, secretary, Lowell City Railway Co.

Mansfield, O.—Clark Rude, president, and Reid Carpenter, treasurer, Citizens' Electric Railway, L. and P. Co.

McKeesport, Pa.—J. C. Smith, president, E. P. Douglas, director, McKeesport and Reynoldton Passenger Railway Co.

Nashua, N. H.—G. H. Knowles, general manager, and John A. Fisher, treasurer, Nashua Street Railway.

New Brunswick, N. J.—G. M. Price, secretary, New Brunswick City Railway.

Norfolk, Va.—James W. McCarrick and N. G. Miller, directors, Norfolk City Railroad Co.

Omaha, Neb.—W. W. Marsh, treasurer, W. A. Smith, general manager, and Frank Marsh, cashier, Omaha Street Railway Co.

Orange, N. J.—Francis M. Eppley, president, Orange Cross Town and B. Railway Co.

Paterson, N. J.—H. Romaine, vice-president, and T. H. Bakewell, director, Paterson Railway Co.

Peoria, Ill.—H. R. Woodward, vice-president, Central Railway Co.

Philadelphia, Pa.—Charles E. Ellis, president, and Thomas S. Manning, director, Citizens' Passenger Railway Co.; E. J. Moore, president, Lombard and South Street Railway Co.; J. J. Sullivan, president, Fifth and Sixth Street Passenger Railway Co.; T. Potts, president, Second and Third Street Railway Co.

Petersburg, Va.—George Beadle, proprietor, Petersburg Street Railway Co.

Providence, R. I.—W. H. Bronsdon, general superintendent, Union R. R. Co.

Philadelphia, Pa.—E. B. Edwards, president, Ridge Avenue Passenger Railway Co.; Chas. D. Matlack, secretary, and Thos. D. Rulon, superintendent, car department, Second and Third Street Railway Co.

Pittsburgh, Pa.—John G. Holmes, president, C. M. Gormly, secretary, and J. E. Rugg, superintendent, Citizens' Traction Co.; D. F. Henry, president, Wm. H. Graham, secretary, Wm. McC. Ramsay, electrician and superintendent, and Wm. A. Stone, solicitor, Federal Street and Pleasant Valley Passenger Railway Co.; S. J. Macfarren, secretary and general manager, Schenley Park and Highlands Railway Co.; George W. Elkins, president, Thomas S. Bigelow, vice-president, E. W. Davis, superintendent, J. W. Reed, auditor, Pittsburgh Traction Co.; C. L. Magee, president, Duquesne Traction Co.; George I. Whitney, president, Central Traction Co.

Raleigh, N. C.—John C. George, president, Raleigh Street Railway Co.

Reading, Pa.—B. J. Owen, president, and Albert Welheimer, director, Reading City Passenger Railway Co.

Rochester, N. Y.—C. K. Minary, general manager; H. Sellers McKee, chairman Executive Committee, and Murry A. Verner, director, Rochester Railway Co.

Salt Lake City, Utah—W. R. Reid, superintendent, Salt Lake City Railway Co.

Salem, Mass.—Nathan E. Morton, superintendent, Naumkeag Street Railway Co.

Scranton, Pa.—J. H. Vandeveer, general manager, and J. H. Bichford, engineer, Scranton Street Railway Co.

San Antonio, Tex.—W. H. Weiss, president, San Antonio Street Railway Co.

Savannah, Ga.—J. H. Johnson, president, George Parsons, director, and Harry Parsons, engineer, City and Suburban Railway Co.

Sioux City, Iowa—James F. Peavey, president, Sioux City Street Railway Co.

Syracuse, N. Y.—A. Bartlett, superintendent, Consolidated Street Railway Co.

St. Paul, Minn.—Thomas Lowry, president, St. Paul City Railway Co.

St. Joseph, Mich.—W. Worth Bean, president, St. Joseph and Benton Harbor Railway Co.

St. Louis, Mo.—Robert McCulloch, vice-president, Benton Bellefontaine Railway Co., Cass Avenue and Fair Grounds Railway Co., Citizens' Railway Co., and general manager, St. Louis Railroad Co.; James Adkins, secretary, and George W. Baumhoff, superintendent, Lindell Railway Co.; John Mahony, vice-president, People's Railway Co.; John Scullin, president, Union Depot Railway; D. R. Hamilton, president, and Smith B. Galt, director, St. Louis Railway Co.

Springfield, Mo.—Frank B. Smith, secretary, and A. H. Rogers, director, Metropolitan Railway Co.

Taunton, Mass.—George C. Moss, superintendent, Taunton Street Railway Co.

Terre Haute, Ind.—Willard Kidder, vice-president, and C. Kidder, director, Terre Haute Street Railway Co.

Toledo, Ohio.—Albion E. Lang, vice-president, and Fred. H. Lincoln, electric engineer, Toledo Consolidated Street Railway Co.; D. Robinson, Jr., president, J. J. Robinson, secretary, and G. B. Perkins, director, Toledo Electric Street Railway Co.

Toronto, Canada.—George W. Kiely, president, William McKenzie, vice-president, James Gunn, secretary, C. C. Woodworth, treasurer, and H. H. Everett, general manager, Toronto Railway Co.

Trenton, N. J.—P. E. Hurley, assistant superintendent, Jonathan H. Blackwell, F. W. Roebling and Chas. Y. Bambard, directors, City Railway Co.; Lewis Perrine, Jr., president, and B. V. Hill, superintendent, Trenton Horse Railroad Co.

Troy, N. Y.—Charles Cleminshaw, general manager, and Charles H. Smith, superintendent, Troy and Lansingburg Railway Co.

Utica, N. Y.—O. T. Crosby, president, and W. E. Baker, vice-president, Utica Belt Line Railway Co.

Washington, D. C.—Wm. J. Stephenson, president, and R. F. Baker, treasurer, Columbia Railway Co.; G. T. Dunloys, Washington and Georgetown Railway Co.; W. J. Stephenson, president, and R. F. Parker, treasurer, Columbia Railway Co.; George Truesdale, president, and F. H. Clark, director, Eckington and S. H. Railway Co.

Waterbury, Conn.—Waterbury Street Railway Co.

West Haven, Conn.—Israel A. Kelsey, president, and Samuel A. Stevens, secretary and treasurer, New Haven and West Haven Horse Railroad Co.

West Superior, Wis.—S. T. Norvell, president, Douglass County Street Railway Co.

Wilmington, Del.—Preston Lee, vice-president, and H. H. Archer, superintendent, Wilmington City Railway Co.

Williamsport, Pa.—H. R. Rhoads, president, and Wm. Haines, superintendent, Williamsport Passenger Railway Co.

Worcester, Mass.—J. B. Chapin, superintendent, Worcester Consolidated Street Railroad Co.; Samuel Winslow, president, W. B. Ferguson, director, Worcester, Leicester and Spencer Railroad Co.

Wheeling, W. Va.—J. M. Sweeney, president, and W. E. Harrington, superintendent, Wheeling Railway Co.

York, Pa.—William H. Lenius, president, D. K. Trimmer and Frank Geise, directors, York Street Railway Co.

FIG. 2.—EXHIBIT OF THE STORAGE BATTERY PLANT OF THE KOLNER ACCUMULATOREN WERKE, AT THE FRANKFORT EXHIBITION.—FROM A PHOTOGRAPH BY OUR SPECIAL CORRESPONDENT.

Upon the completion of the roll call, the following companies were admitted to membership in the Association by application of their representatives:

Schuylkill Electric Railway Co., Pottsville, Pa.

McKeesport and Reynoldton Passenger Railway Co., McKeesport, Pa.

Boston and Revere Electric Railway Co., Boston, Mass.

Second Avenue Passenger Railway Co., Pittsburgh, Pa.

Allegheny Traction Co., Pittsburgh, Pa.

Allentown and Bethlehem Rapid Transit Co., Allentown, Pa.

Amsterdam Street Railway Co., Amsterdam, N. Y.

Duquesne Traction Co., Pittsburgh, Pa.

Lebanon and Annville Street Passenger Railway Co., Lebanon, Pa.

Shenandoah G. and A. Street Railway Co., Shenandoah, Pa.

Citizens' Street Railway Co., Vincennes, Ind.

Consolidated Street Railway Co., Syracuse, N. Y.

Pawtucket Street Railway Co., Pawtucket, R. I.

Citizens' Electric Railway Co., Mansfield, N. Y.

Oil City Street Railway Co., Oil City, Pa.

Colorado Springs Rapid Transit Railway Co., Denver, Colo.

Montreal Elevated Street Railway Co., Montreal, Canada.

Letters from past-presidents Julius S. Walsh, St. Louis, Mo.; C. B. Holmes, Chicago, Ill., and C. A. Richards, Boston, Mass., were read, expressing regret at their inability to be present at this meeting.

The president, Henry M. Watson, then delivered his address, as follows:

Gentlemen of the Convention: The warmth of our reception, even in the preliminaries of this Convention, proves that we made no mistake when we selected Pittsburgh as the place of our tenth annual meeting. This city is famous for her hospitality. The glow of a thousand furnace fires is reflected in the hearts of her people. Most of us learned this long ago. We are no strangers in Pittsburgh. For years we have depended upon Western Pennsylvania for our iron, and in this new era of electric and cable power very many of us must look to the Keystone State for our coal. A double reason, therefore, presents itself why we should cultivate the most cordial relations with the people of this section; but a deeper and more worthy sentiment than any motive of self-interest underlies our liking for this city—the bonds of fraternity. Six of the companies whose horse-car, cable and electric lines thread the valleys and climb the hills which form the ups and downs of Pittsburgh are earnest and zealous members of our Association, and while we are here we hope to gather in the other companies also.

The most important matters to be discussed in Convention will be the problems which arise in the application of electricity to street railway traffic. It is a source of no little satisfaction to us to know that, in the development of the electric railway, America leads the world. Three years ago there were only 18 electrical roads in the United States; now there are over 400, and the advices from every part of the country indicate that before the close of the present year the number will be increased to 500. The capital now invested in American electric railways exceeds $75,000,000. "Horse sense" counts for but little in this age of rapid transit. We old dogs have been obliged to learn new tricks, and without the usual privilege of serving an apprenticeship. Our stables are being converted into power houses; the electrician has taken the place of the veterinary surgeon; our drivers are being educated as motor men, and most of us have horse cars for sale. It is well for us that at such a time, when a thousand unsettled questions perplex us, we can come together in this organization, with the memories of nine other gatherings still warm in our hearts, to exchange experiences, compare notes, and give to each other helpful information. Our cities and large towns are becoming as hungry for street railways as the people of the West are for steam roads, and the bulletins of the new census reports show that in 54 of the largest American cities the mileage was nearly doubled between the years of 1880 and 1889, the figures being 1,983 miles in 1880, and 3,150 miles in 1889.

The following statistics have been compiled from returns made by street railway companies in the United States and Canada to the middle of September, and are believed to be as reliable as it is possible to make them:

Total number of miles, 11,030; number of miles operated by animal power, 5,443; by electricity, 3,009; by steam motors, 1,918; by cable, 660; total number of cars employed in street railway traffic, 36,517; number of cars operated by animal power, 25,424; by electricity, 6,732; by cable, 3,317; by steam motors, 1,044; the number of horses employed, 88,114; of mules employed, 12,002; of steam motors, 200; number of companies operating street railway lines, 1,003; by animal power, 537; by electricity, 412; by cable, 54; engaged in building new lines, about 75.

It is interesting to note that since November, 1890, the number of horses employed on street railway lines has fallen from 116,795, to 88,114; that is, 28,681 in one year. At this rate, it will not take long to emancipate the horse from street railway business.

According to the official figures taken from one of the street railway journals for the month of October, 1891, Philadelphia leads with 510 miles of single track; and after the Quaker City comes Chicago, with 452 miles; New York with 289 miles; Brooklyn with 285; Boston with 283; St. Louis, 275; Baltimore, 207; San Francisco, 205; Cleveland, 192; Cincinnati, 180; Pittsburgh, 168; Kansas City, 141; New Orleans, 139; Louisville, 132; Buffalo, 110; Minneapolis, 101; Los Angeles, 99; Detroit, 94; Birmingham, Ala., 92; St. Paul, 90; Washington, 85.

The official figures of the census just completed show that in December, 1889, 476 cities and towns possessed rapid transit facilities; and it is now difficult to find any town of 5,000 inhabitants without one or more street railways.

While a large majority of us are interested in electric street railways, electricity will not be permitted to monopolize this Convention. One of the features prepared for

(Continued on page 142.)

Frankfort Electrical Exposition.

The number of visitors at the exposition is increasing every day as the time of closing draws near. Yesterday the one millionth person entered the gates and a great celebration took place. He happened to be a young soldier about 23 years of age, and they carried him on their shoulders and two bootlegs of the brown nectar were brought and he was obliged to finish one himself, while the other was passed to the different members of the Prüfungs Commission. The exposition closes October 19, at noon, and the exhibit may be certainly called a success in every sense of the word. After the close, the Lauffen-Frankfort-on-the-Main transmission experiment will be continued, and the pressure on the line will be raised from 16,000 volts to 30, 40 or 50,000 volts, until the insulators give way. Then will come the interesting part of the experiment. As soon as the report is made of the test, the result will be communicated, immediately, to the ELECTRICAL REVIEW.

We have great pleasure in showing a photo, Fig. 1, which, in itself, may not be called a success as a photo, but, from the way it was produced, is of great interest. This photo was made by means of the first electric light produced by the first current turned on at Frankfort, which was transmitted from Lauffen. On the right is Herr Oscar Van Miller, of München, one of the engineers and designers of the Lauffen-Heilbronn plants. On the left, sitting on the dynamo, is Herr von Dolivo-Dobrowolsky, electrician of the Algemeine Electricitäts Gesellschaft, of Berlin, and inventor of the apparatus used in the Lauffen-Frankfort transmission.

The exhibit of the Kolner-Accumulatoren-Werke, Gottfr. Hagen, Kalk bei Köln am Rhein, may be seen in the illustration, Fig. 2. This is one of the principal storage battery companies of Germany and is doing a large business.

There are two sets of accumulators to be seen in the Accumulatoren Hallen show. One battery of 36 cells (type A 30) has a guaranteed capacity of 600 ampere hours; maximum current used in charging, 168 amperes; maximum current used in discharging, 200 amperes. It supplies 135 (Glüh lampen) incandescent lamps at 16 candle-power for 10 hours, or 250 lamps, 16 candle-power, for three hours. The weight of the electrodes is 146.4 kilogrammes.

The other battery consists of 52 cells (type A 30) and is used in connection with the exhibit of the Actien Gesellschaft, "Helios." They work at a normal voltage of 90 volts, and in discharging in 10 hours have a capacity of 1,080 ampere hours.

Contrary to some reports that America is not represented at all at the Frankfort-on-the-Main Exposition, we find that by looking the matter up we may find some American exhibits which are of interest.

Probably the largest exhibit of apparatus which may be called American is that of the Thomson-Houston Company. The exhibit is somewhat divided up. In the main machinery hall is a compound dynamo machine, with a capacity of 40,000 watts; the current supplied is 180 amperes at 220 volts pressure, and is used to operate the mining machinery in the Thomson-Houston pavilion and also in the model mine. In the main machinery hall also is to be seen in operation a series arc machine of 17,500 watts, the current being used to operate arc and series incandescent lamps in the hall. The current used is 10 amperes and the machine supplies nineteen 2,000 candle-power arc lamps and 51 incandescent lamps of different candle-power.

Also in the Thomson-Houston pavilion, near the hall for medicine and science, may be seen an electric boring machine and pumping apparatus operated by an electric motor. The motor used for this purpose develops five horse-power, and the speed of the motor is 1,840 revolutions per minute, while the pump is geared down to 40 revolutions per minute. The weight of the pump is 2,900 kilogrammes, and, at a working efficiency of 60 to 70 per cent., can force 925 litres of water 18 metres high per minute.

The drill is a percussion drill of the Van Depoele type; the weight without standard is 207 kilogrammes and delivers 325 strokes per minute. The length of stroke is 137 millimetres and the drill will displace 45 cubic centimetres of hard granite per minute. The diameter of the drill is 38 millimetres and the consumption of power is about one and one-half to two horse-power. At the top of the pavilion floats the American flag, about the only one to be seen at the Exposition. Within the pavilion may be seen the map of the United States, which covers nearly one wall of the building and contains red marks showing Thomson-Houston stations in the United States. In this building is also seen a windlass operated by a 15 horse-power electric motor. This windlass raises a car loaded with blocks of granite on an incline track. The speed of the armature of the motor is 700 to 1,200 revolutions per minute and the winding drum from 24 to 41 revolutions per minute.

In the mine (model) is an electric crane, the magnet carrying a weight of 1,000 kilogrammes.

The Weston Instrument Company have a very fine exhibit under the charge of Prof. R. Q. Heinrich. There are in use ampere meters of different sizes, from 0 to 150 amperes and from 0 to 1,500 amperes; milli-

FIG. 1.—HERR MICHAEL VON DOLIVO-DOBROWOLSKY (SITTING) AND GROUP OF ELECTRICAL ENGINEERS AT THE FRANKFORT EXHIBITION.—FROM A PHOTOGRAPH BY ELECTRIC LIGHT, TAKEN BY OUR SPECIAL CORRESPONDENT.

ampere and millivoltmeters for continuous currents; continuous current voltmeters, 0 to 6,000 volts, and alternating current voltmeters having scale readings from 0 to 1,200 volts. These instruments are greatly admired by the engineers here and this company has had the honor of having their instruments chosen by the Prüfungs Commission for making the official tests of all the machinery at the Exposition.

The Otis electric elevator has been daily crowded to its utmost capacity and has carried many thousands of people to the top of the great tower.

P.

Frankfort, October 8.

Chicago, Ill.—Acme Light, Heat and Power Company; capital, $2,000,000. Promoters, Geo. S. Knapp, James A. Turner and Simeon J. M. Bear.

New York.—The A. C. Seibold Company, of New York, to manufacture and sell electrodes for arc lamps and other devices, appliances, supplies and apparatus connecting with or used in electric lamps, and for electric lighting; capital, $5,000. Directors, Albert C. Seibold, Edgar O. Clark, William Sowdon, Henry Hoyt, Otto F. Seibold and Lawrence Kneeland.

New Electric Elevator Work.

The first elevator to be operated upon the new principle invented by Mr. H. Ward Leonard was tested recently and the result was an unqualified success in every particular. The elevator is that in the central station of the Edison Electric Illuminating Company, of Brooklyn. The operation of the elevator is controlled entirely by the movement of a handle in the elevator car, and the operation of the elevator is under the most perfect control. The smoothness of the motion of the elevator, both in increasing and decreasing the speed and in reversing the direction of motion, is extremely surprising to those who have been used to the peculiar sinking sensation experienced in the modern high speed elevator.

Electricity Applied to the Taming of Wild Animals.

Waldemar Otto, editor of the German paper *Artist*, has obtained a patent for a method to tame and train wild animals by means of an electric whip. The cage has a metallic floor connected with one pole of a sufficiently strong battery, while the other pole by means of a wire is connected with the whip, which is made of fine twisted metallic wire, while its insulating handle has a button with which the current can be tried if desired. If, now, the wild animal which has to be "educated" shows obstinacy, the trainer presses the button and this gives to the animal an electric shock at every contact of the whip, of which the severity is regulated according to requirements. If the electric current is not needed, the button is not pressed and the effect of the whip is reduced to that of an ordinary one.

This is a new application of electricity for educational purposes, of a class of beings which thus far has been the most inaccessible to impress with the advantages of civilization. In this way the lion may be made to lie peaceably with the lamb, even when the lamb is not inside the lion.

Logansport, Ind.—The Logansport Electric Light and Power Company; capital, $60,000. Promoters, R. T. McDonald, E. J. Hathorne and Joseph Seiter.

Peoria, Ill.—The Secretary of State has issued to J. E. Hall, M. P. Agnew and S. D. Mills authority to organize the Colchester Electric Company, with a capital of $6,000.

New York, N. Y.—The Franklin Electric Company; capital, $5,000,000.

Lafayette, Ind.—W. B. Hislop Electric Company; capital, $10,000.

Jersey City, N. J.—American Telephone Booth Company; capital, $10,000.

Belleville, Ill.—Belleville Electric Railway Company; capital, $100,000.

New York, N. Y.—The Alexander-Chamberlain Electric Company; capital, $1,000.

Oyster Bay, N. Y.—Oyster Bay Electric Light and Power Company; capital, $5,000.

Boston, Mass.—The Hingham Electric Light Company; capital, $2,000,000; 40,000 shares.

Janesville, O.—Merchants' and Manufacturers' Telegraph Cable Company; capital, $10,000.

Union Hill, N. J.—Hero Electric Company, to manufacture electric batteries; capital, $50,000.

Pittsburgh, Pa.—Chartiers Valley Street Railway, to operate an electric street railway; capital, $30,000.

Jersey City, N. J.—The Munsie-Coles Electric Railway Equipment Company; capital, $500,000.

Scottdale, Pa.—The Citizens' Street Railway Company, to operate an electric street railway; capital, $50,000.

Washington, D. C.—The Hanson Battery, Light and Power Company, incorporated in West Virginia; capital, $1,500,000.

Scottdale, Pa.—The Scottdale, Everson and Broadford Street Railway, to operate an electric street railway; capital, $30,000.

Allegheny, Pa.—The North End Passenger Railway Company, to operate a cable or electric street railway; capital, $200,000.

Scottdale, Pa.—The Nickel Plate Street Railway Company of Scottdale, Mt. Pleasant, to operate an electric street railway; capital, $12,000.

Barre, Vt.—Granite City Electric Company; capital, $50,000. Promoters, E. L. Smith, P. S. Currur, of Barre, and E. D. Blackwell, of Montpelier, Vt.

Chicago, Ill.—Chicago and Central American Company, to deal in and export to Central America railroad, telegraph and telephone supplies; capital, $5,000,000.

Portland, Me.—Sphu-Electro Power and Development Company; capital, $2,500,000. President, Aaron F. Smith, Lynn, Mass.; treasurer, Charles H. Tigh, Peabody, Mass.

Pittsburgh, Pa.—Cumberland Electric Light Company, incorporated in West Virginia; capital, $100,000. Promoters, James S. Humbird, Harvey L. Childs and Frank S. Marr, all of Pittsburgh.

Buffalo, N. Y.—Cataract Electric Company, of Buffalo; capital, $40,000. Promoters, Charles A. Sweet, Franklin D. Lecks, Edmund Hayes, William Hamlin and Patrick H. Griffin, all of Buffalo.

Mifflinburg, Pa.—The Mifflinburg Electric Light and Power Company; capital, $1,000. Promoters, Jas. H. Snodgrass, John A. Beard, Aaron Kloss, Wm. A. Ewing and Robert E. Snodgrass, all of Mifflinburg.

Butler, Mo.—Butler Electric Light and Gas Company; capital, $15,000. Promoters, Arthur L. McBride, Thomas W. Legg, Thomas W. Silvers and George W. Canterbury, of Butler, and John A. Keller, of St. Charles, Mo.

ELECTRICAL REVIEW

Published at 13 Park Row,

P. O. Box 3329. NEW YORK.

EDITOR:
CHARLES W. PRICE.

ASSOCIATE EDITORS:
STEPHEN L. COLES.
ROBERT H. READ.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," NEW YORK.

"1546 CORTLANDT." TELEPHONE CALL.

BOSTON OFFICE:
W. I BARKER, Room 29, 620 Atlantic Ave.

WASHINGTON OFFICE:
GEO. C. MAYNARD, 1409 New York Ave.

CHICAGO OFFICE:
L. W. COLLINS, 435 "The Rookery."

EUROPEAN OFFICE:
CHARLES FFRENCH, Editor for Europe.
HOTEL VICTORIA,
Northumberland Ave., Charing Cross, London, W. C.

Cable Address: - - "Electview," London.
Telegraphic Address: Ffrench, "Victoriola," London.

ADVERTISING DEPARTMENT,
H. T. RICHARDS, Manager.

PATENT BUREAU,
ROBT. H. READ, Manager.

Patents procured in United States and all foreign countries. Searches, Investigations and Reports on Validity and Infringement.

SUBSCRIPTION TO THE
ELECTRICAL REVIEW.

One Year, United States and Canada, - $3.00
One Year, Foreign Countries, - - 5.00
Single Copy. - - - - - - - .10

ANNOUNCEMENT.

Address all communications and make all money orders and checks payable to order of ELECTRICAL REVIEW, P. O. Box 3329, New York.

No attention will be paid to communications for the REVIEW without the *name and address of the writer.*

NEW YORK, OCT. 31, 1891.

CONTENTS.

	PAGE.
Views, News and Interviews	135
The Dwight Slate Machine Company's New Semi-Automatic Pinion or Gear Cutter	135
The New Lighting Station in Boston	135
American Street Railway Association	135
Frankfort Electrical Exposition	137
New Electric Elevator Work	137
Electricity Applied to the Taming of Wild Animals	137
New Corporations	137
Another Gain of Power by Electricity	138
More Electric Transmission by Means of Water Power	138
The Tenth Annual Street Railway Convention.	138
Correspondence:	
Our Boston Letter	139
Our Cincinnati Letter	139
Personal	139
World's Fair Department of Electricity	139
Gulcher Thermopile	139
Free Lectures for Engineers and Electricians	139
Howard's Improved Telephonic Apparatus	140
Improved Safety Catch	140
New Electric Light Plant in St. Petersburg	140
Edison's Carbon Battery	140
Centering Generator or Motor Armatures	140
New York Electrical Society	140
The Removal of the Phœnix Glass Company	140
American Institute of Electrical Engineers	140
Literary	141
The Erie City Iron Works' Automatic Cut-off Engine	141
Union Electric Manufacturing Company's Switch	141
World's Fair Notes	141
General Notes	141
Kindred Interests	148
Electrical Patents	148

INDEX OF ADVERTISERS.

COVER PAGES.

	PAGE.
Ansonia Brass & Copper Co.	xxii
Armington & Sims	xxii
Baker & Co.	xxii
Brush Electric Co.	xxi
Bridgeport Brass Co.	xxii
Day's Kerite Insulated Wires	xxii
Eastern Electric Cable Co.	xxii
Hampson & Co., E. P.	xxii
Jewell Belting Co.	xxii
Keasbey, Robert A.	xxii
Moore, Alfred F.	xxii
Okonite Co.	xxii
Schuyler Electric Co.	xxi
Standard Underground Cable Co.	xxii
Wainwright Mfg. Co.	xxi
Westinghouse Electric & Mfg. Co.	ii
Wilmot & Hobbs Mfg. Co.	xxii

INSIDE PAGES.

Alexander, Barney & Chapin	xx
Allentown Foundry & Machine Co.	xvii
American Bell Telephone Co.	ix
American Casualty Insurance and Security Co	xiii
American Electrical Works	xiii
American Electric Elevator Co.	xii
Ball Engine Co	xix
Barnes Co., W. F. & John	xvii
Belanger Freres	x
Berlin Iron Bridge Co.	xiii
Bernstein Electric Co.	xvii
Bishop Gutta Percha Co.	xii
Bridgeport Machine Tool Works	xvii
Buckeye Engine Co.	xvi
Burton Electric Co.	xiv
"C. & C." Electric Motor Co.	vii
Central Electric Co.	vii
Church & Sleight	x
Cladin & Kimball	xii
Cralle & Co., J. B.	xix
Crocker-Wheeler Electric Motor Co.	xvii
Crosby Steam Gage & Valve Co.	xii
Dixon Crucible Co	xvi
Dwight Slate Machine Co.	x
Edison General Electric Co.	vi
Edson, Jarvis B.	v
Electrical Engineering Co.	148
Electric Construction & Supply Co.	xv
Electric Merchandise Co.	xiv
Electric Secret Service Co.	xix
Electro-Light Engraving Co.	xvi
Elektron Mfg. Co.	iii
Empire China Works	xvi
Equitable Engineering & Construction Co.	ix
Eureka Tempered Copper Co.	xvi
Evans Friction Cone Co.	xii
Falls Rivet & Machine Co.	xviii
Faraday Carbon Co.	x
Fletcher & Fletcher Electric Co.	x
Fort Wayne Electric Co.	xx
Garvin Machine Co.	xvii
Globe Co.	xvi
Gordon & Co., W. H.	xix
Greeley & Co., The E. S.	viii a xvii
Haines, Jones & Cadbury Co.	iv
Hay Horn Mfg. Co.	148
Heisler Electric Light Co.	xvii
Holmes, Booth & Haydens	vii
Imperial Porcelain Works	x
Independent Bung Co.	viii
Interior Conduit & Insulation Co.	xvi
Kulp, D. H.	ix
Ladd, Alfred W	xiv
Lane & Bodley Co.	ix
Law Telephone Co.	148
Leclanche Battery Co.	xiii
Lehigh Valley Creosoting Co	ix
Leonard & Co., H. Ward	xix
Marshall, Wm.	xvii
McCreary Electrical Specialty Co.	xvi
National Carbon Co.	ix
New England Butt Co.	xiv
New York Belting and Packing Co.	xiv
New York Safety Steam Power Co.	ix
Noye Mfg. Co., John T.	xiv
Ostrander & Co., W. B.	xiv
Paiste, H. T.	xiii
Parker-Russell Mining and Mfg. Co.	viii
Phœnix Glass Co.	viii
Phosphor-Bronze Smelting Co., Ltd	xix
Pond Engineering Co.	ix
Popple & Co., W. L.	148
Prentiss Tool & Supply Co.	148
Queen & Co.	148
R. I. Telephone & Electric Co.	148
Reddaway & Co., F.	xix
Ridlon & Co., Frank	148
Roebling's Sons Co., John A.	xvi
Rollason Gas Engine Co.	vii
Royce & Marean	xiv
Russell Electric Co.	xii
Sawyer-Man Electric Co.	viii
Schieren & Co., Chas. A.	148
Shultz Belting Co.	xiii
Sigourney Tool Co.	ix
Simplex Electrical Co.	xiii
Solar Carbon & Mfg. Co.	xvii
Sperry Electric Mining Machine Co.	xiii
Standard Paint Co.	xvii
Star Electrix Co.	x
Star Iron Tower Co.	x
Thomson-Houston Electric Co.	v
Tropical American Telephone Co.	viii
Truex & Vail	xix
United States Electric Lighting Co.	xviii
Universal Arc Lamp Co.	xii
Union Electric Mfg. Co.	iii
Waddell-Entz Electric Co.	xvi
Walworth Mfg. Co.	iii
Washburn & Moen Manufacturing Co.	ix
Watson & Stillman	x
Western Electric Co.	vii
Wheeler Condenser & Engineering Co.	vii
Williams & Potter	viii
Wyckoff, Seamans & Benedict	148

The United States Fish Commissioners' steamer "Albatross," which has been taking soundings in connection with the laying of the proposed cable between the United States and Hawaiian Islands, returned to San Francisco October 24. Silinas Landing, in Monterey Bay, is regarded as the most suitable landing place for the United States end of the cable.

Now that the season of electric light and railway conventions is over for this year, interest centers in the plans and doings of other electrical organizations. The Institute of Electrical Engineers holds an important meeting this week and the Electric Club offers its members a novel entertainment for Thursday night. These bodies and the New York Electrical Society have varied and interesting programmes in store for the Winter season.

We present in this issue of the REVIEW a reproduction of a photograph of Dobrowolsky, the inventor of the rotary current system of long distance transmission of power in use in Germany. The photograph was made under an electric light produced by power transmitted from Lauffen to Frankfort, a distance of 108 miles. The readers of the REVIEW are familiar with the ingenious method and will be glad to see the electrician who devised it.

The Frankfort Electrical Exhibition closed October 19. The report on the long distance power transmission experiment will be awaited with interest. The exhibition seems to have been a complete success.

Stephen Vail, in a letter to the New York *Sun*, states that the first telegraph message was "A patient waiter is no loser." This was sent by his father, Alfred Vail, through three miles of bonnet wire at the "factory" at Speedwell Iron Works, Morristown, N. J., January 6, 1888.

ANOTHER GAIN OF POWER BY ELECTRICITY.

The intended improvements of the principal glen, or rather cañon, of the Harz mountains, is encouraged by the imperial German government, as it is found that far from detracting from the romantic scenery there, as was expected at first, it will be an improvement on a magnificent scale, by the intended erection of a dam 200 feet high, which will, at the upper portion of the glen, provide for a cataract of that height and may be electrically illuminated by means of the surplus water power created by the new long lake above the dam, which will be navigable for several miles and form a most romantic change in the otherwise uniform narrow valley.

To this must be added the most important advantage of the gain of 6,000 horse-power, being 20 times greater than the 300 horse-power lately so successfully transmitted from Lauffen-on-the-Rhine to Frankfort-on-the-Main.

At the same time the dam will regulate the unequal rise and fall of the water of the narrow stream, which thus far has often given rise to intermittent inundations and at other times to a kind of water famine. No wonder that the plan is looked upon favorably by all the inhabitants, high and low, who expect great advantage of so rich a gift as 6,000 horse-power, practically equivalent to 18,000 horses, needing no hay and oats.

MORE ELECTRIC TRANSMISSION BY MEANS OF WATER POWER.

The success of electric transmission, as demonstrated at the late exhibition at Frankfort-on-the-Main, has stimulated many of the small industrial towns in Switzerland to utilize the power of the many falls by which they are surrounded at comparatively short distances. The last number of the *Electrotechnischer Anzeiger*, published in Berlin, reports that the government of the Canton of Berne has granted concessions to the towns of Biel, Erlach, Neuenstadt, Nidau and Täuffelen, to utilize the water powers within their reach, which amounts, on the average, to 1,000 horse-power.

The first step is to connect the watershed of the Jura mountains by leading the water of the river Aar through the Hagnek canal, and then to the Bieler lake. The falls of river Aar, near Aarberg, are 30 feet high, and near Hagnek, eight feet will be utilized, while 250 cubic feet of water will be drawn for the Aar canal, near Aarberg, and the rest stored for fish culture. When the water is high the amount discharged, near Hagnek, is 30,000 cubic feet per second. The electric conductors will be about 50 miles long. Four large hydraulic motors, each of 250 horse-power, have been ordered. The motors will be established just above the river mouth, in the Bieler lake. The power obtained will be used for public benefit in the towns mentioned, while the government will execute the work and guarantee the funds. The contractors have to begin work within two years and finish the work in six years.

The preparatory labor had already been started with vigor, when they were lately retarded by work at the Frankfort exhibition. The cost of construction will be rather high, and is expected to be as much as 1,000 francs per horse-power, so that the establishment of 1,000 horse-power will cost 1,000,000 francs, but when once completed it will be far cheaper than any of the other means now used for obtaining power, such as coal, gas, petroleum and other fuel for the production of steam.

THE TENTH ANNUAL STREET RAILWAY CONVENTION.

The tenth annual meeting of the American Street Railway Association, held at Pittsburgh, last week, was undoubtedly the most successful in the history of the Association, both in point of large attendance and in the practical interest manifested in the addresses read before the meeting and the discussions which followed.

Electric traction, as acknowledged in the meeting several times, has made a record for itself which cannot be ignored; and, as a result, a most proper and fitting place was accorded to methods of electric propulsion of street cars in the proceedings of the Convention. This is most gratifying, both to the manufacturers of electric railway motors and appliances and to those who have advocated this method from its inception.

Our report of the meeting includes some valuable statistics regarding the advances made in the construction of electric railways during the past few years. This, together with the discussions of the several methods of electric propulsion, are worthy the study of all street railway men. In this connection it is timely to express the hope that these records of progress may be kept in as complete a manner as possible, because, in this widely expanding field of electrical progress, history is being made every day. Each year renders these records of more value.

The meeting was carried on in a business like way, characteristic of hustling, bustling, American street railway men. It was a real pleasure to hear the practical questions and replies. The responsibilities involved in the safe and profitable conduct of a street railway corporation will not admit of any other methods than those which are business like, consequently this feeling prevailed at the meeting of the Association.

The electrical exhibits evidenced the fact that great progress had been made during the past year, both as regards details of construction, and in the fact that gearless motors were here prominently exhibited for the first time.

The geographical formation of the city of Pittsburgh makes it an unusually interesting place from the street railway man's point of view. An opportunity was offered to study nearly every form of grade and curve besides this, nearly every make and type of electric motor is in use in that place.

Considered from any standpoint the meeting was a thorough success, and if as long a step of progress can be noted at the next annual meeting of the Association, both street railway men and manufacturers of electric apparatus should be eminently gratified.

It is encouraging to note the rapid advances now being made in electric elevator work. One of the novel features of the Frankfort exhibition was an electric elevator of American manufacture.

Mr. Edison is quoted by the New York *Herald* as saying that he has demonstrated the practicability for commercial uses of an electric railway fed with current entirely by the rails, and that Henry Villard intends to have the system in operation between Chicago and Milwaukee, with cars running at 20 minute intervals, during the World's Fair. Particulars of the new system will be looked for with eager interest. No disclosures of the novel features have been made, but it is evident from Mr. Edison's remarks that very low potentials will be used and heavy rails. The difficulty of making contact in all conditions of weather is the one chiefly discussed in the reported interview; the question of leakage and short circuits is not referred to.

CORRESPONDENCE.

OUR BOSTON LETTER.

Dr. A. F. Mason, general manager Simplex Electric Company, this city, was prevented by illness from attending the recent street railway convention.

The Edison System is being installed in the Stark mills, Manchester, N. H. This isolated plant will have a lighting capacity of 2,400 incandescents.

President Brooks, of the American Circular Loom Company, did not attend the Pittsburgh convention as he had planned doing; sickness detained him at home.

The Wright Electrical Engineering Company, of this city, has been awarded the contract for wiring the factory of the Hartford, Conn., Rubber Company for 200 incandescent lights.

The Thomson-Houston Motor Company has shipped 50 of its new "W. P." electric motors to California recently. The company is steadily increasing its business and the outlook is very encouraging.

"Commercial Electricity" will be the subject of the lecture to be delivered by Mr. H. C. Spaulding before the Society of Arts next Thursday evening, October 22, at the Institute of Technology.

The Thomson-Houston Electric Company has declared a quarterly dividend of $1 per share, payable November 14, to stockholders of record November 4. The company intends to erect two additional factories at West Lynn, Mass.

Feed Wires for Trolley Systems are being furnished in large quantities to various electric railways by the American Circular Loom Company, of this city. The popular "canvas jacket" insulation is the product of the company named.

The W. S. Hill Electric Company, this city, has appointed Mr. E. A. Desmarets agent for the Middle States, with headquarters in New York city. General Manager Poor states: "Our company, though organized but recently, is doing a very satisfactory business."

The Lamprey Protector for mouth of boiler furnace is being extensively adopted. Several electric light companies are using this meritorious protector. These include Edison Electric Illuminating Company at Fall River, Mass., and Montpelier, Vt., Electric Light and Power Company.

The Wrought Iron Casting Company, of Boston, Mass., is installing a Thomson-Houston isolated electric light plant in the company's new mill at South Boston. The plant will have a lighting capacity of 26 arc lights and 400 incandescents. Four electric motors, also of the Thomson-Houston type, will be added to the electric equipment of the new station.

The Mexican Telephone Company is reported "to be earning $1,500 net per month." The re-construction of its plant in the City of Mexico is in progress. It is intended to push the work energetically, so as to finish the new exchange and its equipment within four months, and it is estimated that the company's earnings will then be increased to $2,000 net per month.

Electric Road between Boston and Malden.—The West End Street Railway Company is rapidly extending its electric road from Boston to Malden. It has wires laid as far as Everett already, and the work is being rapidly pushed toward this city. It expects to have it all completed and cars running by April 1. It is expected that cars will be run between Boston and Malden, each way, every 15 minutes, from 7 A. M. until 10 P. M.

Mr. Charles H. Herrick, the well-known and expert electrical engineer, of this city, who recently prepared the plans for the new light and power station of the Haverhill Electric Light Company, at Haverhill, Mass., is personally superintending the erection of the station, and will have charge looking to the placing of the equipment. The power capacity of the new station will consist of the following engines, viz., four "Harris-Corliss," each of 250 horse-power; two "Harris-Corliss," each of 350 horse-power, and one "Ball" engine of 100 horse-power.

Erie Telegraph & Telephone will declare the usual quarterly dividend of 1 per cent., payable November 16, to stock of record November 7. The statement for the quarter ending September 30, 1891, shows for Cleveland Telephone Company, the Northwestern Telephone Exchange Company and the Southwestern Telegraph & Telephone Company:

	1891.	1890.	Increase.
Gross earnings..	$213,372	$195,903	$17,469
**Op. expenses.	155,804	135,792	15,012
Balance.....	57,568	60,111	*2,543
†Dividends.....	48,000	48,000	....
Surplus.....	9,568	12,111	*2,543
Subsc'rs added..	194	276	*82
Total subsc'rs..	13,733	12,938	795

*Decrease. **Includes dividends on Bell company's stock. †Includes in 1891, $5,040 surplus of sub-companies, portion of which belongs to Bell company, and in 1890, $7,821.

Mr. F. S. Pearson, chief engineer and electrician of the West End Railway Company, this city, has started on a two weeks' trip, and will visit several Western cities and towns in the interests of the great electric enterprise with which he is connected.

Boston, October 24. W. I. B.

OUR CINCINNATI LETTER.

Mr. J. W. Godfrey, of the New York Insulated Wire Company was in town last week talking up "Vulca" duct.

Capt. George N. Stone, general manager of the telephone exchange here, reports that there are now between 3,800 and 3,900 subscribers connected with the central office.

The Triumph Compound Engine Company reports business good. A number of these engines are operating isolated electric light plants in this city with great satisfaction. The *Commercial Gazette* Company is using one to run several type-setting machines recently installed.

The Cincinnati Tool Company have met with great success with their lineman's pliers, recently illustrated and described in the ELECTRICAL REVIEW. They have also had quite a run on their long bell-hangers' bits. Last month's business was the largest this company has ever had.

The Creaghead Engineering Company has just taken a contract for 153 incandescent and four arc lights, to be installed in the Sechler carriage factory. The Creaghead trolley line insulator, illustrated and described in last week's issue of the ELECTRICAL REVIEW, will be pushed extensively, as the company consider they have a good thing in it. Accurately tested fuse wire is another specialty this company makes, and which is meeting with a ready sale.

The Card Electric Dynamo and Motor Company is doing quite a large isolated lighting and power business. They have recently gone into electric elevator work, with perfect satisfaction to themselves and their customers. Their shops are kept very busy in this direction, as there is a considerable demand for elevator work in Cincinnati. This company has also recently received a large number of inquiries relating to the equipment of large factories with electric power.

The Standard Electrical Works report a very large demand for Roebling's trolley wire and Okonite feed wire, for both of which products they are agents. This company is installing an 800 light plant in the new Neave building at Fourth and Race streets. Western Electric Company's dynamos and Buckeye engines are used. This plant will probably be immediately increased to 1,200 lights. Other recent installations by this company were 800 lights in Pike's Opera House and 1,000 lights in the Cincinnati Hospital.

"The Hon. A. Worth Spates," well-known to your New York readers as the organizer of a Telephone Subscribers' Association for the Reduction of Rates, has turned up here under the name of A. J. Guise, and is attempting to work the same old scheme of "five dollars down and the balance when the rates are reduced." He has for a side partner ex-Congressman Leedom, a gentleman whose reputation is vulnerable, to put it charitably. This amusing pair had not been in town long before Captain Stone was on their trail and had his patrons warned. They got themselves interviewed by the Cincinnati *Post* and then the *Post* thought it had better interview Captain Stone. The Captain's remarks made interesting reading. He has the records of both these gentleman and if they don't let Cincinnati telephone subscribers alone, these records may get into print, and then there will be spicy reading. S. L. C.

Cincinnati, October 20.

PERSONAL.

Mr. Geo. H. Roe, of San Francisco, is visiting New York, with headquarters at the Electric Club.

Mr. Thomas J. Fay, formerly of the Maine Electrical Improvement Company, has accepted a position with the Crocker-Wheeler Electric Motor Company, of this city.

Mr. Herbert Laws Webb, formerly assistant electrician of the Metropolitan Telephone and Telegraph Company, of this city, has accepted a position with *Electricity*, of Chicago. Mr. Webb is a fluent and entertaining writer, thoroughly well informed on electrical matters, and will be a valuable member of the editorial staff of this new journal. Mr. J. W. Dickerson has retired from the editorship, owing to illness brought on by overwork. The best wishes of his friends are extended to him. Mr. Irving Washington has also resigned as business manager.

World's Fair Department of Electricity.

We have received the following interesting communication:

CHICAGO, October 22, 1891.

TO THE EDITOR OF ELECTRICAL REVIEW:

I beg to report the following items that may be of interest to you.

The classification of this department has been finally completed and is now in the hands of the printers. It has been changed but slightly from the classification published some months ago and all changes are in the interest of the department.

The rules of the department governing exhibitors have been formulated under my supervision by my assistant, Mr. Keller, and are now in the hands of the director-general for his approval.

The prospectus of the department has been completed by my assistant and is also in the hands of the director-general for approval, from whom it will go to the committee on electricity. It contains all information that it is thought any one could desire and will aid intending exhibitors in determining the probable cost of their exhibit.

A recent letter from my secretary, Mr. Hornsby, written in Frankfort, states that he left for Nuremburg, on the 7th inst., to visit Schuckert & Company. From there he goes to Berlin, Cologne, Breslau, Dresden, Vienna, Buda-Pesth, Paris and London, to visit the works of the most prominent manufacturers met at the Exposition. He has been sufficiently encouraged there to visit these places. He is already assured of extensive and complete exhibits. Hartman & Braun, of Bockenheim, assure him that they will make a magnificent display of their justly celebrated electrical instruments, etc. Dr. Hoepfner, the well-known electro-chemist of Giessen, was visited and promised a complete exhibit of his method of electrolytic extraction and purification of copper and other metals.

Dr. Werner Siemens has expressed a willingness to make a fine exhibit.

Professor Ferraris, of Turin, Italy, wishes to visit the Fair and the electrical congress especially. He says that he hopes the date for the congress will be fixed for August, 1893, as all of the professors of Europe have their vacation during that month and a better attendance could be had.

Frederick August Haselwonder, so prominently connected with the Lauffen transmission scheme, promises to exhibit a wonderful street railway conduit and has made, in connection with Michael von Dolivo-Dobrowolsky, of the same enterprise, an assertion that they are ready to transmit 1,000 to 5,000 horse-power from Niagara to the World's Fair at a pressure of 50,000 volts over a bare wire. The Ganz people of Vienna talk of running an electric road from the Exposition grounds to St. Louis, making the run every half hour.

A number of letters, telling the location of interesting historical apparatus and relics to be gathered in the historical section, have been received by my assistant, Mr. E. E. Keller, and it is hoped that all persons having such apparatus or knowing of its existence, will correspond with him.

Yours respectfully,
J. P. BARRETT,
Chief Department of Electricity.

Gulcher Thermopile.

The improvements in the Gulcher thermopile, which was exhibited at the Frankfort Exhibition, according to the London *Electrical Engineer*, consist chiefly in the employment of a positive electrode consisting of an alloy of antimony not easily fusible and very durable; further, in the use of nickel as negative electrode, and in an arrangement for preventing the overheating of the place of junction. The remarkable feature of this thermopile is, in addition to its great durability, its great efficiency, greater than has hitherto been obtained by any similar apparatus. The model shown in operation at the exhibition has an electromotive force of four volts and a current of five amperes, at a consumption of 200 litres of gas per hour. The working expenses are, therefore, about one farthing per hour. It will thus be seen that the Gulcher thermopile, per cubic metre of gas, gives a total electrical energy of 100 watts, whilst the best apparatus of this kind hitherto constructed only gave about 24 watts per cubic metre of gas. A still higher efficiency than the batteries heated by gas is shown by the batteries intended for production of large electrical energies and arranged for heating with coke. In these the elements are grouped around a common stove, and other improvements have been adopted to increase the efficiency. A thermopile constructed after this principle, and consuming two kilogrammes of coke per hour, gives 80 volts and a current of 10 amperes. A battery of this description would suffice for feeding eight glow lamps of 16 candles continually, or with the help of accumulators, 30 of these lamps for six hours per day. Such a battery, it is stated, would supply light for a house of moderate size, and not only light but also heat, by placing, for instance, the stove in the basement and heating the house by hot air pipes. The smaller type of this interesting apparatus is already in the market, and constitutes an excellent generator for electroplating, chemical and physical laboratories, for charging accumulators, for working electro-medical and dentists' apparatus, for replacing galvanic batteries in telegraphy and telephony and other purposes. The larger type is being tested for its durability, and is shortly to be brought into the market. The apparatus is manufactured by Julius Pintsch, of Berlin.

Free Lectures for Engineers and Electricians.

The free lectures given by the Lowell fund will commence the first week in November at the Wells' Memorial Institute, 987 Washington street, Boston. These lectures will be thoroughly practical, designed to meet the needs of workingmen and mechanics, and include the following topics: Electricity, elementary; electricity, advanced; steam and the steam engine; sanitary engineering and building construction. There will be 15 lectures on each of the above topics. The lectures on electricity will be given on Friday evening of each week for the elementary lectures and on Tuesday evenings for the advanced course. The lecturer is Prof. Wm. L. Puffer, of the Institute of Technology, and he will have at his command all necessary instruments and apparatus, a one horse-power electric motor, the Edison circuit, the arc light circuit, the alternating circuit, and a lantern for projections. None of the lectures will require a knowledge of mathematical subjects.

The lectures on steam and the steam engine will be given by Thomas Hawley, editor steam department of the Boston *Journal of Commerce*, commencing Tuesday evening, November 3, and on each succeeding Tuesday evening. The lecturer will discuss the following topics: Merits and defects of different engine valve systems and boilers; different methods of heating, direct and indirect; high and low pressure steam and exhaust; belts and belting; shafting; the testing of engines and boilers, and the practical use of the indicator.

The lectures on building construction and architectural drawing will be given by Prof. E. W. Smith, Tuesday evenings.

All of these lectures are free to every one, without any restriction other than to apply for tickets at the office of the Institute on the evening of the lecture or before. Engineers, firemen and those interested in electrical matters should attend these meetings. They will, undoubtedly, find them of benefit.

The great success of the 300 horse-power lately received at Frankfort-on-the-Main, from the famous falls of the head-waters of the Rhine in Switzerland, is stimulating all the industrial centers in Switzerland where they have plenty of water power, thus far utterly wasted for centuries, and that in a country where they have no coal, petroleum or natural gas, and a limited supply of any kind of fuel, all of which we have plentifully in our country. The greatest advantage of the Swiss mountain streams is that they never fail, as in the hot season they are chiefly fed by the melting of the snow between the tops of the Alps, and by the continual descent of the glaciers in the valleys. It appears that all over Germany the public attention is called to this waste of useful power, which thus far has been going on for thousands of years, and appears at last to become useful for the benefit of man, by the agency of that great and mighty power which he has succeded in bridling and harnessing as his servant.

Howard's Improved Telephonic Apparatus.

In the accompanying engravings, Figs. 1, 2 and 3, are illustrated several improvements in telephone apparatus to be used in a subscriber's station, recently patented by Mr. James H. Howard, of Medford, Mass. Fig. 1 illustrates an improvement by which, when the apparatus is in its normal position, the resistance of the receiving telephone magnets is short-circuited, and the resistance of the generator armature is also short-circuited, thus leaving interposed in the line resistance only the bell magnet, and thus materially decreasing the resistance of the line. When, however, the receiver is removed from its book it is automatically cut into the line by a spring switch, so that conversation may be heard. A similar automatic arrangement applied to the magneto generator cuts its armature into circuit when a crank is turned to ring the bell. As illustrated in the diagram, Fig. 1, the receiver d has been removed from the hook, and in this condition the line current will pass from the main wire b, through conductor f, bell magnet, wire f^1, f^4 and f^8, and out on line a, the microphone shown at h having its circuit automatically closed by the approach of the two spring controlling arms i, i^1. When, however, the telephone is inserted between these arms, their contacts are forced apart, thus causing arm i^2 to bridge two contacts at j^1, and short-circuit the telephone by leading the line current by way of b, f, bell magnet, wire q, spring contact 5, to a segmental contact on the magneto crank shaft, next to the frame of the magneto, by wire m^1 across the closed bridge just described, by wire m and f^5 to main wire a. The generator shaft has mounted upon it an

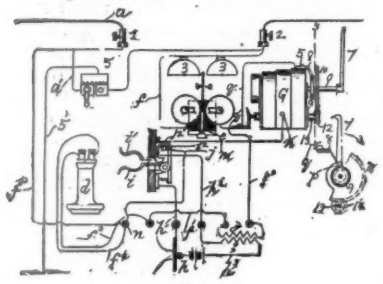


FIG. 1.

insulating disk in which is a single contact stud upon which the insulated spring 8 bears when the apparatus is at rest, thus closing the short circuit just traced and cutting the magneto armature out of the line circuit. When, however, the crank 7 of the magneto is turned, the spring 8 leaves the contact and rubs upon the surface of the insulated disk, thus opening the short circuit and cutting the armature of the magneto into line by way of spring q^1 and wire m^1. The crank shaft of the magneto is controlled by a coil spring so that the signal is sent in by the reaction of said spring after the crank has been turned by the subscriber. It is claimed that greater ease and accuracy of signal can be maintained with this structure than where the magneto armature is driven directly by the hands of the operator, and it enables a repetition of calls with accuracy, so that one of the subscribers may be called by a repetition of the number of rings.

Fig. 2 illustrates an improved hook designed by the same inventor for telephones. In this no dependence is placed upon the weight of the telephone to cut it out of cir-

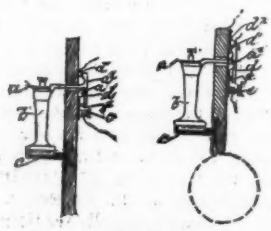


FIG. 2.

cuit, but in order to avoid failure of springs a positive action is secured by providing a shelf c upon which the telephone rests, and having a fork a forced inward by the interposition of the telephone, so as to open the circuit. When, however, the telephone is removed, the fork drops its own weight, being assisted by a spring f, and cuts the telephone into circuit.

Another device invented by Mr. Howard for cutting the telephone out of circuit is illustrated in Fig. 3. The coil of the telephone has its two ends terminating in contact plates b b on the outside of the instrument. A sliding ring is pressed by the tension of a spring so as to cover these contact plates when the telephone is removed from the supporting hook, so that under these

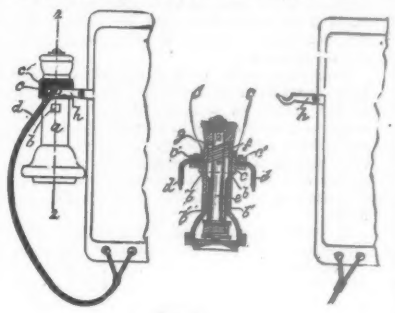


FIG. 3.

conditions the plates b b will be engaged by corresponding contacts on the ring and the coil will be in circuit and conversation can be heard. When, however, the telephone is hung upon the hook its weight is sufficient to overcome the tension of the coil spring, thus forcing the ring out of contact with the plates b b and cutting the coil out of circuit. The circuit is completed by the arms of the hook h which form a short circuit to wires d which lead from the line to the telephone.

Improved Safety Catch.

An improved safety catch proposed by John W. Howell, of Newark, N. J., is composed of a rod or filament of carbon, or gun powder, or some other similar material which will conduct the current and be capable of chemical disintegration when raised to a high temperature in the air. A safety catch of this character is claimed to be of special service in the protection of telephones, telegraphs, electric clocks, indicators, etc., which are liable to be burned out when their circuits become crossed with the circuit carrying an abnormally heavy current. A composition of this character can be readily manufactured in sizes which will instantly

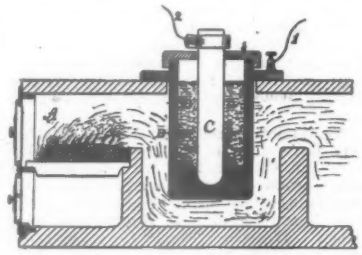
heat on carrying the abnormal current, and thus be raised to incandescence, when the reaction upon them by the oxygen of the air will disintegrate them and thus open the circuit. A safety catch of this character with its clamps and supporting base is illustrated in the accompanying diagram.

New Electric Light Plant in St. Petersburg.

The St. Petersburg *Journal* states as follows: "The Military Medical College has selected the centennial anniversary of Faraday to lay the corner-stone of a central station for the electric illumination of the Medical College, the Michael Artillery Academy, the Polytechnic School and the Military Prison School. The first idea originated two years ago, while now the plans have been completed under the sanction of Professor Jagorou. The ceremony took place with proper solemnity in presence of the government authorities, the professors of the four institutions, numerous students and a large assembly of the public. The Minister of War, General-Adjutant Wannourkè, opened the exercises, after which Professor Jagorou gave a short biography of Faraday's life and works, while a liberal festival meal was given to all the workmen. The station is intended for 10,000 electric lights."

Edison's Carbon Battery.

Mr. Edison has been recently granted a patent for a rather unusual type of battery, in which carbon is substituted for the zinc ordinarily employed as the soluble or active electrode in galvanic batteries. The electrolyte used is an oxide which is maintained in fusion by externally applied heat, which by raising the temperature of the carbon, enables it to absorb oxygen from the oxide and develop current. A battery invented by Jablochkoff operated also on this principle. Jablochkoff used for his electrolyte nitrate of potash, which is maintained in fusion by the burning carbon, the carbon being first raised to incandescence, the nitrate of potash being fused in a conducting vessel and the piece of ignited carbon plunged into it. The nitrate of potash furnished oxygen to support combustion, which continued as long as the carbon and nitrate lasted; the chemical reaction developed the current, which was taken off from the carbon and the containing vessel. Mr. Edison's battery differs from this in several material particulars. His arrangement is illustrated in the accompanying illustration, wherein A represents a furnace over which is supported an iron vessel B provided with fire clay block a on the bottom, on which is supported a block C made of powdered bituminous coal mixed with a little tar and compacted and coked. The electrolyte is formed of oxide of lead, to which a flux may or may not be added. This is illustrated at B. The heat of the furnace fuses the oxide of lead and raises the carbon to a red heat, when it is acted upon by the



oxide, forming carbonic acid and developing by the reaction current which may be carried off from the two poles 1, 2. Mr. Edison's application upon which this patent was issued was filed in May, 1882.

Centering Generator or Motor Armatures.

In the accompanying engravings is illustrated a dynamo electric machine or motor in which the difficulties of centering the armature within the polar cavity of the field magnets ordinarily experienced are avoided. The structure is the invention of Mr. Ezra T. Gilliland, of New York. In all cases in which the journal bearings for the armature spindle are independent pieces the centering of the journal bearings with reference to the axis of the armature is liable to be untrue, the slightest variation in the adjustment of a nut being sufficient to destroy the accuracy. Ordinarily, in order to avoid this, dowel pins are placed between the support and base, but the necessary play required to permit the assemblage of the

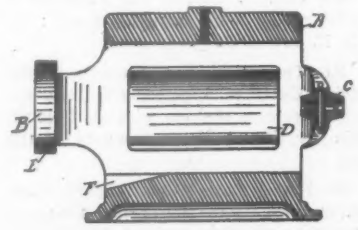


FIG. 1.

several parts will be sufficient to destroy true accuracy of centering. Mr. Gilliland's method consists simply in forming the journal bearing integral with the body of the frame upon which the field magnets are formed. As will be understood from an inspection of Figs. 1 and 2, the frame and bearings are cast in one piece and bored from the side indicated at B, the diameter of the bore being large enough to admit the insertion of the wound armature. From the other end, as at C, a smaller bore is made in order to accommodate the armature shaft. Upon the end of the shaft which rests in the bearing B is mounted a flanged disk, shown at H in Fig. 2, the flange resting against the edge of the bearing B and the bearing surface fitting inside the bearing B. In order to permit the introduction of the field magnet spools or bobbins, a recess is made, as indicated at F, which permits of the inser-

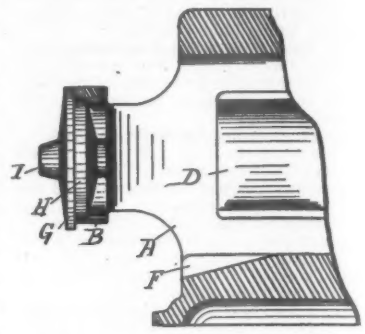


FIG. 2.

tion of the spools within the polar cavity and their superposition on the field magnet core D. By this structure the expense of the frame is cheapened; the weight of the machine is lessened, because it is possible to reduce the size of the base; and perfect axial alignment of the armature spindle and the polar cavity is attained.

New York Electrical Society.

It is the intention of the New York Electrical Society to devote some of its meetings during the season of 1891-2 to a series of experimental lectures in which the treatment of the various branches of electricity will be fitly illustrated by practical demonstration. This series was initiated in Professor Chandler's room, Columbia College, on Thursday, October 22, at 8 P. M., when Dr. Schuyler S. Wheeler lectured on "The Practical Management of Electric Motors." The lecture was of a very practical character and partook of the nature of a friendly chat with the audience.

The Removal of the Phœnix Glass Company.

The New York office of the Phœnix Glass Company, which has been for a number of years at 729 Broadway, will be removed November 1 to 42 Murray street, where increased conveniences have been secured. The Phœnix Glass Company is very widely known in electrical circles for its artistic work in the line of manufacturing electric globes for both arc and incandescent lamps. It undoubtedly does the largest business in this line of any of the manufacturing companies, and it has achieved success by the energetic and progressive management of Manager A. H. Patterson. The removal to Murray street places the New York office right in the midst of large manufacturing houses, and this location will undoubtedly be of great advantage to the company.

American Institute of Electrical Engineers.

The sixtieth meeting of the institute will be held at 12 West Thirty-first street on Tuesday evening, October 27, at eight o'clock. A paper will be read by Mr. A. E. Kennelly on "Magnetic Reluctance."

The paper announced for this meeting by Mr. H. Ward Leonard has been postponed until further notice.

In accordance with a vote at the previous meeting, the discussion on Prof. Harris J. Ryan's paper will be continued.

If time permits, the report of the committee on units and standards will also be taken up.

Members who are especially interested in these subjects may secure advance copies upon application to the secretary, which will be forwarded at the earliest possible moment.

The council will meet in the secretary's office at 5 P. M.

LITERARY.

We have received "Higher Education In Indiana" from the United States Bureau of Education.

In the November issue of the *New England Magazine*, Walter Blackburn Harte makes a plea for a world without books. He thinks that education is not an unmixed blessing, as the greater the intelligence of individuals and peoples the greater is their capacity for suffering.

Lieut. A. B. Wyckoff, U. S. N., has written for the November *Scribner* a paper on "The United States Naval Apprentice System," in which he proposes the extension of the system in a manner to gain recruits from the rural districts of the States, where good American stock is going to waste. He would have the navy recruited from the good boys of the country rather than from the bad boys of the city. "Why should the navy be confined to the seaports, and not have representatives of all parts of the country?" asks Lieutenant Wyckoff. "Recruiting offices could be moved from place to place, advertising thoroughly in advance, and remain only a few weeks in each town. The *personnel* needed could be restricted to three or four persons, and the expense of each party would be small. When a dozen boys had been enlisted they could be sent to the nearest rendezvous. In this way the navy could be Americanized and popularized, for the poor boys of every State would have an equal chance."

The cover of *The North American Review* for November invites special attention to three of the articles which form its attractive list of contents. The first of these is entitled "Russian Barbarities and Their Apologist," and is furnished by Dr. Hermann Adler, chief rabbi of the united Hebrew congregations of the British Empire. The "apologist" with whom he deals is, of course, Prof. Goldwin Smith, whose article on "New Light on the Jewish Question," in the *Review* for August, has occasioned so much discussion. Dr. Adler's paper is an eloquent reply to Professor Smith's strictures. The second "starred" article is "How to Improve Municipal Government"—a symposium to which four experts contribute. They are, ex-Mayor Hart of Boston, Mayor Davidson of Baltimore, Mayor Bishop of Buffalo, and Mayor Noonan of St. Louis. In general they agree that the best model for a city government is the government of the United States, with its division into executive, legislative and judicial departments. No. 3 is Part I. of "Italy and the Pope," by ex-Prime-Minister Crispi, who writes clearly and with full knowledge on this interesting subject.

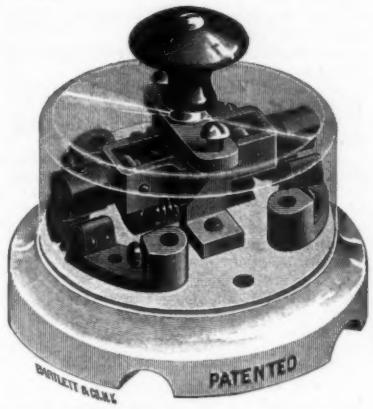


FIG. 1.—UNION ELECTRIC MANUFACTURING COMPANY'S SWITCH—OPEN.

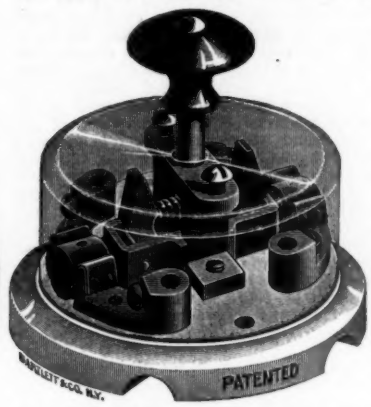


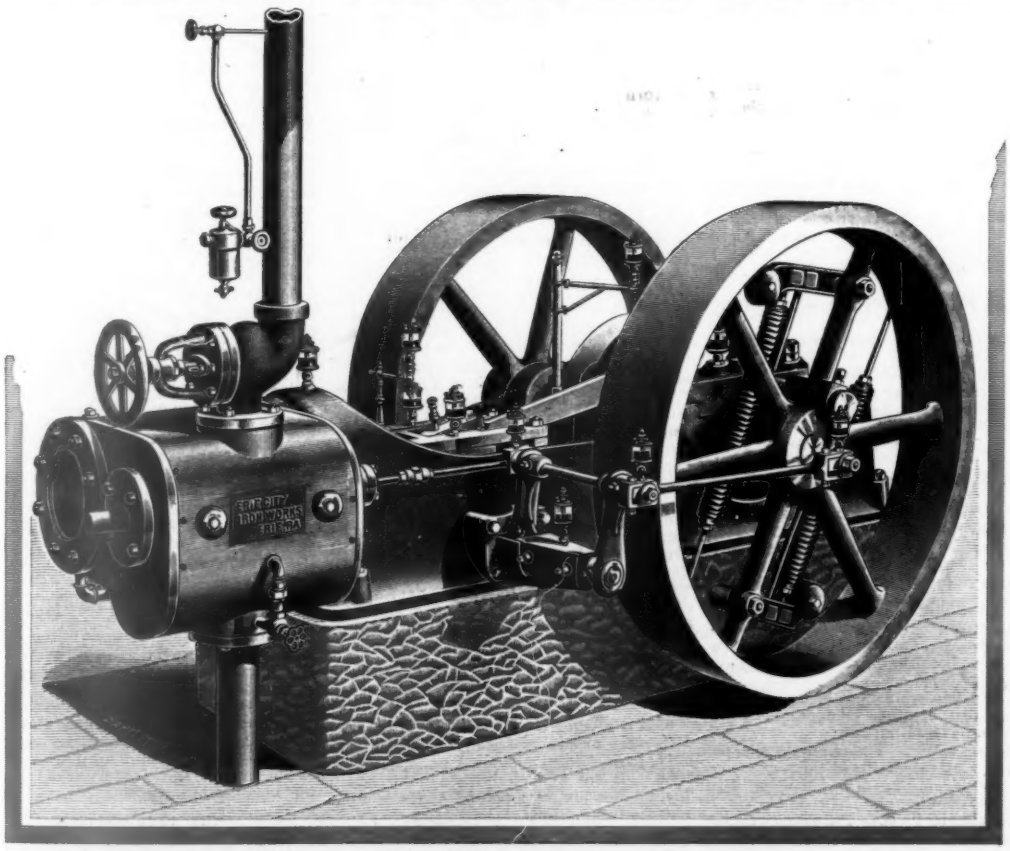
FIG. 2.—UNION ELECTRIC MANUFACTURING COMPANY'S SWITCH—CLOSED.

The Erie City Iron Works' Automatic Cut-Off Engine.

These engines are made by the Erie City Iron Works, Erie, Pa., from new designs and patterns. The beds are very strong and well proportioned throughout, and provided with patent pillow blocks with an improved gib which allows for taking up the wear. The gib is adjusted by a set screw tapped through the solid bed and provided on its inner end with a ball and socket joint.

The steam chest is detachable from the cylinder, and the valve is large and simple in its construction, provided with water groove packing, and accurately fitted and perfectly balanced.

The governor is very simple and sensitive and is locked at the two essential points; the rocker is made with a take-up gib on one side, and has two strong arms through which a steel shaft is passed. Careful tests have proven this to be one of the best high speed engines on the market. Every engine is thoroughly tested under steam, the valves adjusted by indicator, and the regulation assured by an autograph recording instrument.



ERIE CITY IRON WORKS' AUTOMATIC CUT-OFF ENGINE.

Union Electric Manufacturing Company's Switch.

The Union Electric Manufacturing Company, of Bridgeport, Conn., has recently put upon the market the switch illustrated herewith. This switch has been brought out to meet the demands of a discriminating trade, which requires a device as nearly perfect as possible. The fact that the Union Electric Manufacturing Company produce and guarantee this device is sufficient testimony as to its merits.

WORLD'S FAIR NOTES.

The magnitude of the building operations now going on at Jackson Park can be surmised from the fact that an average of from 35 to 40 car loads of construction material arrives daily. The Exposition buildings are rising with wonderful rapidity.

Between 340 and 350 men are employed in perfecting the landscape features of the Exposition site. It is the intention to make the grounds exceedingly beautiful, by walks, drives, lawns, terraces, fountains, shrubbery and flowers. Several hundred thousand dollars are to be expended for this purpose.

The Associated Press has applied to the Grounds and Buildings Committee of the Exposition for suitable space, either in the press quarters on the grounds or in a separate building, where its reports can be prepared and dispatched during the Fair. It is certain that the Exposition authorities will provide extensive press and telegraph facilities, but the details are not yet determined.

GENERAL NOTES.

The street cars in Pittsfield, Mass., are now heated by electricity.

A contract has been awarded for a new electric light building at Peabody, Mass., at a cost of $15,690.

Stillwater, N. Y., is to be lighted by electricity, a contract having been awarded for five years at $500 a year.

A company is now being formed at Royersford, Pa., with a capital of $10,000, to erect an electric light plant at that place.

It is reported that Postmaster-General Wanamaker will renew his recommendation for government control of the telegraph.

The longest horse car line in the world is said to be that connecting the city of Mexico with Galapa, 72 miles. The trip is made in eight hours.

The Abingdon and Rockland Electric Light and Power Company will have their plant in full operation by December 1. The capital stock of the company is $30,000.

A company has been organized by J. E. Hall, M. P. Agnew and S. D. Mills, with a capital of $6,000, and will shortly build and operate an electric light plant at Colchester, Ill.

The Fort Wayne and Elmwood Street Railway Company have decided to change their motive power and will equip their lines with the trolley system, at a cost of about $400,000.

The Laramie Tramway Company are about to build eight miles of electric railway in Laramie City. They will use the trolley system and the plant will cost between $60,000 and $80,000.

The Goshen, N. Y., Electric Light and Power Company, will begin work at once on their new power station. The building will be of brick, 40x50 feet, and will contain two boilers, two engines and four dynamos.

The plans finally adopted by the New York Rapid Transit Commission provide for a tunnel road in the lower part of the city and a viaduct up town. Ample accommodation for way and express trains on different levels is afforded.

The Electric Light Company, of Greensburg, Pa., have purchased a large tract of land immediately south of the town and will begin the erection of their brick power house at once. The plant will be equiped with two 50 arc dynamos and two 100 horse-power engines.

The Central Electric Company are happy over the fact that the sales of Packard high grade incandescent lamps are constantly increasing, and report that there is a great tendency towards using better material in electric light construction. These lamps satisfy the most exacting demands.

The Waterville and Fairfield Power and Light Company have purchased the stock of the Waterville and Fairfield Horse Railroad and the electric light plant of Waterville. The new company will run their cars by electricity in the Spring, and in the meantime their plant at Fairfield is being greatly enlarged.

Work has been begun on the electric railroad between Wellsville, O., and East Liverpool, and is being pushed rapidly forward; 400 men and 65 teams have been at work on the hill between the two cities and have nearly completed the grading of a fine road-bed, cut in some places through 20 feet of solid rock. The road will cost between $300,000 and $400,000 and will be one of the finest equipped in the country.

The annual meeting of the stockholders of the Quincy and Boston Electric Street Railroad, was held last week at Quincy, Mass., and the following officers were elected: President, John R. Graham; secretary and treasurer, Fred. H. Smith; directors, John R. Graham, Roger H. Wilde Winthrop Coffin, John A. Duggan, Arthur Burnham, Thos. H. McDonnell, Wm. A. Hodges, Josiah Quincy and John F. Merrill.

AMERICAN STREET RAILWAY ASSOCIATION.

(*Continued from page 136.*)

us will be the report of a special committee on "A Year's Progress in Cable Motive Power." This is well. We should not become so deeply interested in any one form of rapid transit as to lose sight of the good points of all others.

Where streets are straight and grades are steep and the traffic is limited only by the number of cars that can be operated, a well constructed cable system may have economic advantages that should be better understood. In our boyhood days a galvanic battery could always draw us away from the grindstone, and now, later in life, most of us find the dynamo, the engine and the switchboard of an electric power house far more attractive than the heavy machinery of a cable plant. But if under any conditions the cable system will give the best possible service to the patrons of a road, and make a better showing than electricity on the balance sheets, we want to know it.

This Convention is to be favored also with the third paper on the "Public Treatment of Corporations," by the Hon. G. Hilton Scribner, of New York. It is an old saying that corporations have no souls. Perhaps that is why they are prayed for so little and preyed upon so much. Most of us who have pooled our property, in the belief that we can accomplish more for the people whom we are seeking to serve than by working each with his individual capital, have felt often most keenly the abuse and unjust burdens heaped upon our companies by those who seem to have no conception of what a corporation is or why corporations are formed.

No doubt, we would all be more than pleased if the ripe wisdom and sound common sense contained in these admirable papers by Mr. Scribner, preserved in book or pamphlet form, should be placed in every public library and laid upon the table of every editorial room, where to promote justice is deemed an end more worthy than to nurse a prejudice.

The reports of the four special committees on electrical topics will certainly receive your closest attention, and should be discussed with the greatest freedom. If you have any well digested opinions, which do not accord with the conclusions of the committees, let us have the benefit of your thought and experience.

Since the introduction of cable and electric transit the government, in its wisdom, has found a new use for the street cars. Some of our lines have been elevated to the dignity of United States mail routes. The plan, in bold outlines, is to place on all the cars convenient little boxes for the collection of mail, which is taken up and sorted at some central point, and the city letters sent to the sub-stations, without any of the delays incident to the handling of the mails at the general post office. As an illustration of the workings of such a system, there is on record a well-authenticated instance of the travels of two letters, one of which was dropped in a letter box on a lamp post in a large city, and the other sent from the same point at the same time to the general post office on an electric car. A comparison of the envelopes, subsequently made, shows that the last-named letter actually reached Washington, 400 miles away, at almost the same time that the letter dropped into the box was received at the general post office, only two miles away. In a city where all the cars come to a common center the plan seems most feasable, and companies who have not given this matter due consideration will do well to consult their local postal authorities at an early day.

No doubt, we shall all derive much pleasure and reap great benefit from the Columbian Exposition in Chicago in 1893. It will be learned with no little regret that Mr. Charles B. Holmes has resigned from the World's Fair Committee. Mr. John B. Parsons, of the West Chicago Street Railway, has been asked to fill the vacancy, and, happily for us, he has accepted the appointment. But we shall not have to wait two years yet to learn what the inventors and manufacturers are doing. They are here with us in large numbers, and their exhibits are well worthy of a large share of your time and attention in the intervals of our business meetings.

Only those of us who, at some time in the history of this organization have held the presidental office, can have a clear conception of the large amount of dull routine work devolving upon the secretary and treasurer in the course of a year. If this Association grows and flourishes like a green bay tree, it is because he keeps the roots well watered. If our meetings prove rich feasts of good and wholesome things it is because he is the caterer. We have been most fortunate in being able to continue in office for a term of years a gentleman so earnest and efficient in the discharge of all the duties of this important position as Mr. William J. Richardson.

This Convention ought not to adjourn without expressing, in some manner, its appreciation of the able work of the street railway press. Never more eagerly than now have we watched for the coming of these ever-welcome monthly visitors. The development of new forms of rapid transit has sent us back to school again, and these are our text books. From title page to back cover we scan them through, advertisements and all, in our eagerness to learn the very latest advances in electric, cable and other forms of motive power. Their digests of the important decisions of the courts, their carefully tabulated statistics, their superb illustrations, their detailed descriptions of the power plants and equipments of the most progressive street railways of the world, and their portraits and biographies of prominent street railway men, and their intelligent discussions of all the problems which confront us as a class, are all features which command them to our heartiest support. They would do splendid missionary work in the editorial rooms of some of our leading daily papers, and the local companies would be acting wisely should they arrange to secure, at whatever cost, the exchange of their city papers with the several journals devoted to the street railway industry.

And now, in conclusion, let me thank you most heartily for your attention, and allow me to express the wish that you may enjoy, to the utmost, the good things prepared for us by the several committees having in charge the management for this meeting.

THE EXECUTIVE COMMITTEE'S REPORT.

Pittsburgh, Pa., October 21, 1891.

To the American Street Railway Association.

Gentlemen: Your executive committee respectfully submits the following report:

MEMBERSHIP.

At the opening of the meeting in the city of Buffalo, the membership numbered 169 companies.

At that meeting and during the year the following companies have become members:

Asheville, N. C.—Asheville Street Railway Co.

Attleboro, Mass.—Attleboro, North Attleboro and W. Street Railway Co.

Baltimore, Md.—Baltimore City Passenger Railway Co.

Denver, Colo.—Denver Tramway Co.

Erie, Pa.—Erie Electric Motor Co.

Evansville, Ind.—Evansville Street Railroad Co.

Lancaster, Pa.—Lancaster City Street Railway Co.

Lawrence, Mass.—Merrimac Valley Street Railway Co.

Lexington, Ky.—Passenger and Belt Railway Co.

Newburyport, Mass.—Black Rock and Salisbury Beach Street Railway Co.

Newton, Mass.—Newton Street Railway Co.

Paterson, N. J.—Paterson Railway Co.

Pittsburgh, Pa.—Schenley Park and Highlands Railway Co.

Portland, Ore.—Willamette Bridge Railway Co.

Raleigh, N. C.—Raleigh Street Railway Co.

San Antonio, Tex.—San Antonio Street Railway Co.

St. Joseph, Mich.—St. Joseph and Benton Harbor Street Railway Co.

Springfield, Mo.—Metropolitan Electric Railway Co.

Toledo, O.—Toledo Electric Street Railway Co.

Utica, N. Y.—Utica Belt Line Railway Co.

West Superior, Wis.—Douglas County Street Railway Co.

Wheeling, W. Va.—Wheeling Railway Co.

CHANGES BY CONSOLIDATION.

The Milwaukee Street Railway Co., of Milwaukee, Wis., in place of the Cream City Railway Co. and the Milwaukee City Railroad Co., both the latter companies having been members.

The following companies, being operated and controlled by other companies in the same cities, have withdrawn:

Brooklyn, N. Y.—The New Williamsburgh and Flatbush Railroad Co.

Minneapolis, Minn.—The Minneapolis, Lyndale and Minnetonka Railroad Co.

Providence, R. I.—The Providence Cable Tramway Co.

CHANGE OF NAMES.

The following change of names of members have taken place:

Atlanta, Ga.—Atlanta Consolidated Street Railway Co., in place of the Atlanta Street Railroad Co.

Augusta, Ga.—Augusta Railway Co., in place of the Augusta and Summerville Railroad Co.

Buffalo, N. Y.—The Buffalo Railway Co., in place of the Buffalo Street Railroad Co.

Grand Rapids, Mich.—Consolidated Street Railway Co., in place of Street Railway Co., of Grand Rapids.

Lowell, Mass.—Lowell and Suburban Railway Co., in place of Lowell Horse Railroad Co.

Toronto, Can.—Toronto Railway Co., in place of Toronto Street Railroad Co.

MEMBERS WITHDRAWN.

The following members have withdrawn:

Asbury Park, N. J.—Sea Shore Electric Railway Co.

East Saginaw, Mich.—Saginaw Union Street Railway Co.

Ottawa, Ill.—Ottawa Electric Street Railway Co.

Richmond, Va.—Richmond Railway and Electric Co.

As the result of these changes, the membership is now 180 companies.

At the close of this meeting the membership will, doubtless, exceed 200 companies.

SPECIAL REPORTS.

Committees have been appointed to report on the following subjects, namely: "A Perfect Electric Motor;" "A Year's Progress of Cable Motive Power;" "Public and State Treatment of Corporations, No. 3;" "The Dependent—Overhead or Underground—System of Electric Motive Power" and "The Independent—Storage or Primary Battery—System of Electric Motive Power."

It will be seen that unusual prominence has been given to the subject of electricity; indeed, so much so that this meeting may be fairly called an "Electric Meeting." The committee considered that electricity had rightly earned the consideration which has been accorded it in the several subjects devoted to its consideration along different lines; and the development of the business during the current year has only tended to strengthen the committee in the wisdom of its allotment of so large a part of the time of this meeting to electrical consideration. The preparation of the reports covering the two distinctive systems—dependent and independent—were placed in the hands of men who were thoroughly competent to deal therewith, by reason of their intimate connection in each case with the respective systems. No limit whatever was placed upon the authors as to their treatment of the subjects; and it is believed that the consideration given thereto will be exhaustive. The gentleman to whom was referred the subject "A Perfect Electric Motor," by reason of his long continued and varied experience with electric traction, as well as his extensive knowledge of the street railway business, was considered to be eminently qualified to tell this Association what were the requirements necessary in a perfect electric motor.

"A Year's Progress of Cable Motive Power" is a legacy from last year's meeting. The data upon which the report was to have been prepared for that meeting was not in hand at the time; and, therefore, its preparation and presentation was deferred until this meeting, at the request of the committee—a gentleman who had had extensive experience in cable traction. An exhaustive report has been prepared on the subject and reflects great credit upon the committee. Its author takes occasion to express regret that by reason of serious illness in his family, which necessitated his return to Europe, he is prevented from being present at this meeting and participating in its privileges.

The papers heretofore prepared upon the subject of "Public and State Treatment of Corporations," have been so universally admired for the masterly way in which the subject has been treated, that your committee considered it wise to have a third paper from the same gifted writer.

ADVANCE COPIES OF REPORTS.

A subject which has been under advisement of the Executive Committee is the printing of advance copies of the reports of special committees. It has been deemed wise by some similar societies to have copies of reports of committees printed and distributed to their members from a week to a fortnight in advance of the general meeting, with a headnote, of which the following is a copy, namely:

ADVANCE COPY.

"This advance copy is subject to revision. It is sent to you personally for discussion only; and with the express understanding that it is not to be published or furnished for publication in advance of its regular issue in transactions of the Society.

"....., *Secretary.*"

It is contended that by the printing and circulation of the reports in advance of the meeting, valuable time, which is taken up in the reading of the papers, the contents of which up to that time are unknown to the listeners, could be better employed in the discussion that would take place on the subject and drawn out by the reports which would have been already digested by their readers. There being a difference of opinion, however, as to the expediency of undertaking the publication and circulation of the reports for this meeting, it was determined to be wiser to submit the question for the deliberation and determination of the Association at large.

STREET RAILWAY LAW.

The monthly publication of judicial decisions relating to the street railway business has been continued, and forms part of Vols. VII and VIII, of "Street Railway Law." The numbers, according to issues and titles, are as follows:

1890.—November—Patton *vs.* Philadelphia Traction Co.

December—Nivette *vs.* New Orleans and Lake Railroad Co.

1891.—January—Butler *vs.* Pittsburgh and Birmingham Traction Co.

February—People *vs.* Atlantic Avenue Railroad Co., of Brooklyn.

March—Tippins *vs.* North Side Street Railroad Co.

April—Upham *vs.* Detroit City Railway Co.

May—Henry *vs.* Pittsburgh and Lake Erie Railroad Co.

June—Cincinnati Inclined Plane Railway Co. *vs.* City and Suburban Telegraph Association.

July—Willmott *vs.* Corrigan Consolidated Street Railway Co.

August—Nichols *vs.* Ann Arbor and Ypsilanti Street Railway Co.

September—People's Passenger Railway Co. *vs.* City of Memphis.

October—Measles *vs.* Fort Worth and Denver City Railway Co.

AMERICAN STREET RAILWAY DECISIONS.

The editors of the work entitled "American Street Railway Decisions," having prepared and issued the first volume of the work, report that they have a large amount of manuscript in hand, and propose to facilitate the issue of the work when their manuscript has been completed for the entire publication.

STREET RAILWAY PAPERS.

We desire to again express our sincere appreciation of the many heartfelt and earnest words uttered by the editors of the journals devoted to the street railway industry, in commendation of the value of the Association to street railway companies, with appeals made for a membership co-extensive with the street railway companies in America.

FELLOW WORKMEN.

From a consideration, two years ago, of the subject of "Capital and Labor," to a much milder consideration a year since, of the same general subject, as "Employer and Employé" we give a moment in passing, to a few words upon the subject "Fellow Workmen." Comment was made a year since upon the fact that a number of mutual benefit associations had been organized among the employés of companies that are members of this Association. We are pleased to note that considerable interest has been manifested by various companies during the year regarding these organizations, looking to the establishment of similar societies among their employés. The companies that have such societies under their patronage, and contribute to their support, know by experience how useful they are in bringing about and fostering pleasant relations between the managers and the men, whether in the office, upon the road, or in the shop. These mutual benefit associations tend to harmonize the interests of all, making all, employer as well as employé, feel that they are fellow workmen together. When the time shall arrive that the employé shall have vested interests in the business of the company, essential differences between employers and employés will no longer arise; for the interests of both will then be identical. We shall do well, as managers of great corporations, to do all that lies in our power to hasten the coming of that day.

REDUCED RATES OF FARE.

All the traffic associations in the country but one have, for the past two years, generously accorded to the delegates and others in attendance at the meetings of this Association the courtesy of a fare and a third for the round trip. We regret that this exception is made, and shall continue our efforts to obtain the concession until it becomes co-extensive with the territory which includes our membership.

THE NEXT MEETING.

Your committee desires to call attention to the fact that a hearty invitation has been tendered the Association by the Rochester Railway Company, of Rochester, N. Y., to hold its next annual meeting in that city.

In this connection the committee feels called upon to comment upon the fact that the Association, with its attendant friends and business acquaintances, has become so large in number as to tax to the utmost the hotel accommodations of most cities. It has occurred to your committee that it might be advisable to refer each year the question of the selection of the next place of meeting to a special committee, whose duty it shall be to take under advisement the question of hotel accommodations and special rates at

an inducement for the Association to go to any certain city.

THE PITTSBURGH STREET RAILWAY COMPANIES.

The committee takes occasion to express its grateful recognition of the efforts that have been made by the Pittsburgh street railway companies, and especially by their local committee, to have all the arrangements relative to meeting as complete as possible in the matter of the street railway exposition as well as in the entertainment of the delegates and their friends.

In closing this report we are glad to call attention to the fact that, although the year has been one of unusual mortality, we have not been called upon to mourn the loss by death of any of our representatives. Respectfully submitted, Henry M. Watson, W. A. Smith, Charles Odell, A. D. Rodgers, Thomas Lowry, D. F. Henry, Albert T. Thornton, H. M. Littell, Thomas C. Keefer, *Committee.*

TREASURER'S REPORT.

The treasurer's report was then read, a summary of which is given, as follows:

Receipts.

Balance	$1,780 95
23 admission fees	575 00
1 annual dues, 1887–8	25 00
2 annual dues, 1888–9	50 00
2 annual dues, 1889–90	50 00
153 annual dues, 1890–1	3,825 00
5 annual dues, 1891–2	125 00
"American Street Railway Decisions"	374 75
Banquet tickets, 1890	310 00
Annual reports	7 00
	$7,122 70

Disbursements.

Secretary's salary	$1,500 00
Ninth annual banquet	1,250 00
Ninth annual report	903 70
"American Street Railway Decisions"	694 70
Expenses incident to ninth and tenth annual meetings	255 76
Legal opinions—"Street Railway Law"	202 00
Special committee reports	200 00
Postage	165 00
Miscellaneous printing	109 85
"Public and State Treatment of Corporations, No. 2"	67 75
Expressage	21 58
Telegrams, stationery, insurance	10 30
	$5,380 64
Balance in bank	1,742 06
	$7,122 70

A Perfect Electric Motor.

The report of H. A. Everett on "A Perfect Electric Motor," was presented as follows:

Mr. President and Gentlemen: For the past eight years the writer has been very intensely interested in the perfection of electric motors. The first experiments were made in the Summer of 1883, but during the previous Winter we had been carefully watching the operation of an electric system in the private premises of one of the large manufacturing companies, and had seen the motor operate under all conditions of weather, though, of course, experimentally. We had come to the conclusion that it was just the thing, and had hopes that it would revolutionize travel the world over. On application to the city government, we were given the right to build one and a half miles of railway with an electric conduit. The troubles and vexations we experienced with the conduit are not covered by the title of my paper, and I will endeavor to confine myself to explaining the changes that were required in the motor.

The first fundamental error made by the electricians was in the idea of increasing the voltage in proportion to the number of cars run, which, of course, would be impracticable in a system of any size; but we did not know that then. We got out our experimental car, and quite frequently, for a few hours, it would work magnificently, giving a speed of 22 miles per hour with the utmost ease, and running forward or backward with one or two loaded trailers in fine shape. We were quite well satisfied with the experiment with the one car, but insisted on having a second and third car placed on the line before adopting it generally. We finally got the second car running and were very much dispirited to find that the speed of both cars was immediately reduced to about four miles per hour. This result was, of course, very unfortunate for us. Returning to my subject, in starting in with the motors we tried wire rope transmission from the armature to a drum on the axle, but it did not work at all satisfactorily, the ropes oftentimes stretching too much. We then tried manilla rope transmission, but that also had its weak points, and the change to friction gear also proved unsuccessful. After these various trials, the late Richard N. Allen requested us to allow him to gear it at his own expense, with a system of cog gearing which he was quite sure would prove successful. We very gladly gave him permission to put in the gearing, and (this style of gearing has been practically adopted by all the prominent electrical companies in the country) after trying to operate this line for about a year and three months, we gave the matter up for the time being, believing that it was impracticable either to operate a conduit, or to operate by the system as suggested at that time, though never losing faith in the final outcome of electric propulsion. We examined a great many motors and traveled over a large part of the United States to observe tests made of storage batteries of various kinds, but we were not at all satisfied as to their successful practical operation, and, until we saw the road operating at Richmond with overhead wires, we had no desire to again enter into the matter of electrical propulsion, although it must be admitted that some of our people were willing to put in a system similar to the one at Scranton, even before the Richmond system was in operation. An electrical motor of three years ago should hardly be compared with the motors manufactured at the present time, and, on the other hand, a motor that is considered perfect, or nearly so now, might be considered old-fashioned and obsolete within a much shorter period. We have made several tests of storage battery systems, and have watched with great interest the many tests made in that branch, and, candidly, we must admit that the practical successful application of storage batteries for street railway propulsion seems as far in the future as it did five years ago. Almost all street railway men admit that the storage system, if successful, would be the ideal system, and all hope for its ultimate achievement; and in this age of progress it would be very short-sighted and bigoted to say that it will never come.

All of the prominent companies are eager to perfect their motors in the matter of details, and have cheerfully co-operated with the practical men running electric roads to bring about the improvement of their machinery. All the well known systems of the day have some special points of advantage, but these I will not refer to, as it is not within my province to do so.

The motors when first constructed were altogether too light, both mechanically and electrically, but these difficulties are being overcome very rapidly, as well as the serious difficulty of too rapid motion, which swelled the operating expenses very largely in maintaining the parts and replacing the gearing. The best motors manufactured hereafter will be the most simple in the matter of the construction of the parts, and at the same time not consuming too great a quantity of electricity, so that in addition to being simple they will also be economical. The principle of winding armatures is, of course, a pretty old one now, and each company is anxious to give its patrons the most efficient and best armature. I think it would be an improvement if in all machines made a better insulated wire was used in both armatures and fields; a more reliable and positive fuse wire application, one that would always burn out while still under the capacity of the motor would also be a great improvement.

A great many corporations in operating motors do not appear to be willing to give them proper attention or inspection, with the result that weak points are very soon apparent; but this is in no way the fault of the manufacturer.

The writer expects within a few years, as the motors are perfected with their armature speed reduced, to see a line of railway from New York to Chicago, run on the basis of not more than a two hour time table for the through trip, and giving a transportation rate considered impossible with the present motive power. A great diversity of opinion exists as to the proper size of motor cars, a good many companies holding to the principle that a very large car is desirable and practicable. From our experience in operating cars from 16 to 30 feet in length, I am of the opinion that on routes having a small patronage, where the earnings are under 20 cents per car mile run, it is unwise and undesirable to have a car exceeding 21 feet in length inside, as it is much more economical to have trail cars when the traffic is heavy, rather than to be at the continuous daily expense of hauling a very large car of great weight.

I would again reiterate the fact that motors have been wonderfully perfected within the past year, and if as much progress is made during the coming year, there can be very little to ask in perfecting a motor, although it is very desirable that the mechanical application should be more carefully looked after. I do not think it was the intention to have me criticise, in any way, the special weak points of any system, but simply to refer to the whole question in a general way. If you will pardon a short divergence from the subject, I will relate an incident which occurred last Spring. A gentleman largely interested in street railways made the remark that in the city of New York they would never permit the use of electric motor cars if accompanied with unsightly overhead wires. I asked him if it was quite consistent that so much objection should be made to a system which required but one copper wire, not exceeding three-eighths of an inch in diameter, with posts on either side of the street, 150 feet apart, with a diameter not greater than an ordinary hitching-post, after allowing on the street that beautiful structure, "the New York Elevated Railway," with its perfect (?), odorless, smokeless, noiseless, steam locomotives, and shutting out both light and air to the people on the street where the railway is operated. He candidly admitted that he did not know but that the elevated road was about as bad as the overhead wires.

To resume my subject, at the present time all of the prominent companies are devoting the time and intellects of their best men to the perfection of a gearless motor. They all now have the single reduction motor in the market, which is certainly a wonderful achievement in advance of the late countershaft machines, and which ought to make a splendid exhibit when compared in the matter of operating expenses. But I have noticed one matter which the electrical companies seemed to have entirely overlooked in the manufacture of their apparatus, and I must say that this failure is universal. All of the prominent companies seem to have fallen into the same error, and seem to persistently and maliciously continue in their evil ways. I do not think that any one subject connected with electrical propulsion has received so much attention from the railways as this one, and with so little co-operation and assistance from the electric companies. I, of course, refer to the price of their equipment. It appears to me that the companies, instead of operating 4,000 motor cars, could be operating 40,000 within a very short time if they would bring the price down to a reasonable figure, so that all companies could afford to purchase an equipment. I think it would also be desirable if the electric companies would supply all the extra parts from their shops at a price allowing a reasonable margin for profit.

Before closing this paper, I desire to extend my sincere thanks to all the gentlemen connected with street railways who have so kindly given me the benefit of their experience on this subject.

In summing up my idea of a perfect street railway motor at the present time I would say:

Taking the trolley wheel, pole and stand, I think it desirable to have a wheel that is capable of following the wire at any angle, with a trolley pole brittle enough to break should it become entangled in the wires, without pulling them down, and a trolley spring rigid enough to give good, steady pressure on trolley wire, and so constructed that when the car is in the car house or going under a low bridge the pole could come very close to the roof of the car, also flexible enough to give good pressure when the trolley has to be 21 or 22 feet high at the railway crossings.

The car should have a lamp circuit, with plenty of lamps distributed properly.

The perfect motor ought to have, as hereinbefore suggested, a reliable fuse plug, that will invariably blow before injury is done to the machine.

Have on each car the best lightning arrester that can be secured in the market.

In coming to the motor proper, it is desirable to use a controlling switch that is easily operated and readily reversed in case of accidents. The simpler the controlling device the better, and it should be constructed with a view to guard against any possible disarrangement of the parts, so that it will be reliable in all cases, both electrically and mechanically.

The rheostat should also be carefully looked after and properly protected to keep it from injury, by reason of water, snow or dirt getting upon it. It should only be available in starting the car to avoid the lunge of a start, and should be so arranged as to be cut out as soon as the car is started and give the entire efficiency of the motor proper.

The motor should be well protected in all its parts from any outside interference, so that in running along the street it will be impossible to pick up nails, wire or anything that would short circuit it, at the same time observing that a motor must be properly ventilated to keep it from heating while in use. The cover should be made so as to be easily removed.

I deem it very advisable to have an armature of a large diameter, making a small number of revolutions per minute, with the bearings made of extreme width, with proper grease-cups, and in such a condition that they can be readily re-babbited when slightly worn.

The diameter of the commutator should also be large, and to have the brushes easy of access is very desirable. The winding of the armature ought to be of the simplest kind, and the size of the wire and insulation of same should be carefully looked after. I think the insulation of wires in armatures is at present one of the weakest points in the motor.

The armature gears should have a wide face and run in oil. The armature shaft ought to be of ample diameter, and there is nothing gained by having the key-way too small for the securing of the commutator to the shaft. The commutator should be carefully insulated, so that there will be no grounds between it and the case. The box in which this gear runs ought to be constructed of copper, or some light material that is somewhat flexible, so that if struck from the outside it will bend rather than break. The fields should also be wound with a wire of better insulation and of ample size to take the current. Of course, in this particular, I do not intend that the wire of either the field or armature should be great enough to take more horse-power than ought to be used by the machine. To my mind, it is very desirable to have the armature in such a condition that it can be readily taken out from the machine and put in again.

One of the serious disadvantages to operators of electric roads is the expensive labor necessary in winding the armatures and fields, also in regard to high-priced mechanics who ought to be employed to attend to the machines. There is nothing gained in employing a cheap class of labor to handle en electric equipment, either as electricians, armature or field men or mechanics. This proposition is a self-evident truth, as can readily be observed in many roads now in operation.

At present I think the single reduction motor is the nearest perfection of any on the market.

I think it very desirable that the electric companies should devote some time to the perfection of an electric brake to stop the car with the same power that runs it. This could be readily done and would be a satisfactory improvement.

Electric heaters are now used in quite a number of places, and I think will prove quite satisfactory.

I have noticed electric signal bells on some of the cars, and they seem to work very well.

For a dasher gong on a motor car I am in favor of a foot tread, as in testing an electric gong we found that our men used it altogether too freely.

I am in favor of an oil head-light, one that can be removed easily, so that in the event of a trolley being broken or anything happening to the electric part of the car, or a light is desired underneath the car, the oil head-light can be used to better advantage than the electric. There ought also to be one oil light in every car for the same purpose. There is no reason why an electric fare register cannot be made to work successfully.

The durability of the motor is a question which requires very careful attention. The single reduction motor, when properly looked after, ought to last for many years. We have had one in operation for over 10 months, and it appears to be in as good condition as when it first went on the road. The car should be of moderate size, constructed with all modern convenience, but without fancy decorations or any unnecessary display.

The cars should be run on frequent headway and at all hours of the day and night at as high a rate of speed as the civic authorities will permit. The noise of the motors has been very largely done away with, and by careful attention the old countershaft machines can be used until worn out, by simply covering the gearing with an oil box, and by not attempting to run them too many miles without inspection.

I thank the members of the Convention for their attention to my paper, and trust that it may prove of benefit to some.

Mr. Stephenson, of Washington: In connection with the paper just read in regard to the electric motor power street railways, I would like to have a little information, if possible.

I would like some expression of opinion as to whether or not any more danger to the life and limb of passengers is attended in operating overhead wires than there would be in any other form of electricity, conveyed by an underground wire, for instance. I would like also to get some opinion in regard to the comparative cost in operating electric roads and horse railroads.

Mr. Cleminshaw, of Troy: I can answer one part of the question. I understand a paper has been prepared by one of the electric companies showing the cost in detail of the two systems—the horse and the electric. Statistics from seven standard roads are given. I have no doubt the information will be given to the Convention before we adjourn.

Mr. Charlton, of Hamilton, Ont.: There is one other point that would be of interest to many companies still employing horse power and contemplating the use of electric power. It is this: Whether the revenue derived from a change from horse power to electric power has been as great as has been anticipated, or has been so great as to war-

rant the change; whether the change has paid in cities of moderate dimensions with small populations would be of great interest to many companies who have not changed from horse power.

Mr. Wrenne, of Nashville: I would suggest that this whole question is fully covered in a report presented at the last meeting of the Association, giving the comparative cost of horse, cable and electric railroads.

Mr. Stephenson: I had the honor of being present at the meeting last year and heard the report referred to. It does not quite answer my question. I want some gentleman to tell me his own personal experience, who has operated a horse railroad and then changed to electricity.

Mr. Owen, of Reading: I have read and reread the report referred to; it has saved my company many thousands of dollars.

Mr. Hasbrouck, of New York: As the gentleman is in pursuit of knowledge, I will refer him to a paper read at the annual meeting of the New York State Association. Mr. Beckley, the president for the current year, made a very interesting report on this subject. He is up to his eyes in electricity in Rochester.

Mr. Henry, of Pittsburgh: I have in my hand a copy of my last annual report. Our total cost including conductors and motor men, all repairs, maintainence of way, general expenses and all other charges amounted to 20.26 cents per mile. Separating this into strictly operating expenses and fixed charges, we have operating expense of 12.74 cents per mile, and in comparing the same with the cost of operating the horse line, which was 10 cents per car mile, we must remember that we then paid but one man on a car, where we now pay four or three cents per mile against 6.60 cents now. This increased cost per mile for conductors and motor men is a necessary adjunct of rapid transit, and is not peculiar to the system. Allowing this, we have a difference of 1.04 cents per car mile in favor of electricity as against animal power.

Mr. Bickford, of Salem: I will recite an incident that will, perhaps, answer the question to a certain extent. We have equipped our lines and run 12 cars. Formerly it took 18 cars to do the work 12 now do. One line where we ran 12 cars by horses, we run eight electric cars and carry more passengers.

Mr. Stephenson: That is the general information that I get. We have about 20 cars on our road, and I am satisfied that when we put on electricity 12 or 14 cars will carry the same number of people as the 20 now do. I am also satisfied that we shall have an increase in our travel of 25 or 50 per cent. The point we want to know is, the relative cost between electric cars and the horse cars; how much we are going to make by the change, or how much are we going to lose?

Mr. Pearson, of Boston: I think I can give some information on this subject. Our road has about 350 cars equipped with electric motors, the expense of operation with horses is about 25 cents per car mile, including everything connected with the operation, fixed charges and track repairs. In Boston the cost of operation is quite high as compared with some other cities. You will find in many cities the cost of operation of horse cars is below 25 cents, but we pay a good price for labor, on account of the running of our lines in the congested parts of the city, where we cannot get as much work out of a man as you can in other cities. This makes a greater cost of operation. The cost of operation with electric motors, up to the present, has been about 20 cents per car mile. The increased cost of operation in our city is also true, to a great extent, with electricity. We pay 25 cents a day more for motormen and electric car conductors than we do for horse conductors and drivers. That has been our experience up to this time. We save about 25 per cent.; our men are really expected to work 10 hours a day, but we really get anywhere from seven and a half to nine and a half hours a day. The amount of power consumed is considerably more on account of the slow speed with which the motor powers have to operate in the downtown sections of the city. There the streets are crowded with teams and cars, and I suppose that the cars run at an average of, perhaps, one or two miles an hour for a distance of from one-half to one mile, which, of course, decreases the profits very materially. We expect to get the cost of operation down to 16 or 17 cents per car mile. Another item of expense to us is the high cost of power, we having been obliged to hire power from an electric light company, and pay them a good price for it, of course, much more than it would cost a street railway company if they had their own power house. As I said before, the saving of electric cars compared with the horse system, is about 25 per cent., being about 20 cents per car mile for the electric cars and 25 cents per car mile for horse cars.

Mr. Richardson: I would like to ask Mr. Pearson, before he takes his seat, what size cars his company has operated in its electrical propulsion and what size he thinks, from his experience, would be the best and most economically operated, all things considered.

Mr. Pearson: We began with a 16-foot motor car, very similar to the old horse cars. We have changed from that to a long car, which is 26 or 28 feet long in the body and 35 feet over all; that is the car we have adopted as our standard. For our purpose we find a decided improvement in earnings and saving in operating expenses per passenger with the long car. I imagine that the conditions in Boston determine that for us, and in other cities it may be that the short car would be more profitable for operation. We find the long car earns a great deal more per car mile, and we have only the same number of men to operate it as with the short one. From our tests we find that the amount of power consumed on a level track is very little more for the long car than with the short one; in fact, the weight which we have in the car seems to have little to do with the current consumed, as long as the car is on a level track. From tests we found that a long car, empty, weighing, perhaps, 18,000 pounds, using a certain average amount of current, that the same car loaded with 15,000 pounds of weight used very little additional power until we come to a grade. We have experimented in this matter and could hardly tell from the reading which was the empty and which was the loaded car. That being the case, it does not cost much more to operate long cars than short cars. Again, they carry nearly double the people, and do it with the same expense for conductors and drivers. Just how much more heavy cars will increase the track repairs of course we cannot tell at present. The last line that we have started has 26 long cars. When I came away they were running 55 cents per car mile, compared with, perhaps, 30 or 35 cents per car mile. Our experience has been that the long cars are the best for our purpose.

WEDNESDAY EVENING'S SESSION.

The session opened at 8.30 o'clock, and the first business was the reading of the report on "A Year's Progress of Cable Motive Power."

The President announced the next business to be the reading of the report on "The Dependent—Overhead or Underground—System of Electric Motive Power."

The Dependent—Overhead or Underground—System of Electric Motive Power.

BY GEO. W. MANSFIELD.

In treating of the "Dependent System," I have arranged the various applications of electricity to railroading under four headings, or, I might say, into four methods: First, the underground; second, the surface; third, the overhead, and fourth, the storage battery.

FIRST, THE UNDERGROUND METHOD.

This, I might possibly divide into two classes: First, continuous bare conductors placed in an open slotted conduit; and second, all other devices of automatic character which enable the contact piece or device on the car to take its electric current from sectional bare conductor or from bare metallic points, automatically made alive. There have been, in this country, at least, four practical experiments with the first class, several hundred thousand dollars have been expended in testing it, and thousands additional in perfecting it, particular attention being given to the protection and insulation of the bare conductor. In spite, however, of all this refinement and study, practically nothing has been accomplished, and I have no hesitation in asserting that the continuous live conductor in an open slotted conduit is to-day a failure.

No large practical experiments have been made with this second class, but a large number of patents have been issued. I, however, have no hesitancy in asserting that this class also will never prove a success. The reason is obvious. It is immaterial whether the automatic devices prevent the sections or contact points from being alive all of the time or not, if the conduit is filled with water or mud, and the points are made alive just as the car passes, there is bound to be a momentary grounding from these points. Numerous ingenious schemes have been devised to overcome this fatal weakness. None, however, have ever been put to trial.

One inventor placed his bare conductor in a rubber tube made something like a hose pipe. Arranged upon the upper side of this tube are the contact points, which might be likened to rivets punched or tapped through the tubing. The contact wheel or device rolls along the top of this tube, and is sufficiently heavy as it proceeds to press the tube together so that the contact points or rivets come in contact with the conductor inside the tube. By this means the current is transmitted to the motors. Obviously, as the car proceeds the tube behind the contact wheel springs back into its original position. Plainly, however, if the conduit was filled with water, there would be an inevitable grounding of the points made alive, with consequent trouble and disaster. Another arrangement was to have inside the conduit a large elastic tube with a bare conductor inside, this tube to be slit along its upper side. Attached to the car is a plow with a contact device at its lower end inside the tube and in contact with the conductor. This plow moves along with the car and slides through the slit. With this arrangement it is apparent that if the conduit were filled with water it would run in just before and behind the plow. Should this occur, the old fatal trouble would be bound to follow. Furthermore, it would be exceedingly difficult to arrange the tube sufficiently rigid in position to withstand the action of the plow and the sides of the slit sufficiently tough to withstand the friction. The question of turnouts would also be serious and troublesome.

Another inventor arranged on each side of his conduit slot rubber flaps shod with steel and held together by means of springs. Attached to the car is the plow as usual. As the plow passes along in the conduit it presses back the flaps. The objection to this is, of course, the liability of the water getting into the slit before and behind the plow. To obviate this the inventor ingeniously suggested that the whole conduit be kept under an air pressure, which air pressure would be sufficient to blow the water out at any of these open places where it tended to run in. I do not consider that any of these plans can ever be successful. We now come to the second or surface method.

With the inventions covered by this method, by far the larger number of arrangements are based upon what might be called the "Interval" or "Point" system. Primarily this arrangement consists of an underground insulated conductor connected by means of taps to contact points on the surface of the ground, held in place by means of iron boxes and insulated therefrom by means of rubber, wood, fibre or other similar substance. Upon the car is swung a long contact plate, extending practically from one end to the other. This plate is carried close to the ground, and is arranged to touch the points as it passes along. It is plainly apparent that if these contact points are always alive, then every time the street is covered with water, short circuits are inevitable. To overcome this, many automatic arrangements have been devised to cut these contact points into circuit by the car as it passes along. One inventor had electro-magnets on his car, which imparted their magnetism to the iron contact pins or points. These becoming magnetized would lift a little armature inside the iron casing, which in turn moved a switch and cut the iron contact points into circuit. Another inventor arranged a slot between his tracks, in which the plow passed. As this plow passed the contact points, it would tip a lever or some other automatic device, which would throw a switch and put the iron contact points into circuit. Obviously, all these arrangements have the same fatal weakness—a liability to ground or short circuits. There is one more system which practically combines all these methods, and which obviates many of the objections. The inventor has a slot between his rails and boxes with a contact device within, placed at proper intervals. Upon his car is a plow which passes along through the slot, and also a long contact plate or arrangement extending its entire length. The operation of the invention is as follows: The plow as it passes through the slot strikes a lever placed in connection with each box, which lifts for a distance of six or eight inches above the ground a piston carrying the contact piece proper. This is made in the shape of a right angle hook placed within a vertically moving piston, and thoroughly insulated from it. As this is raised up, the long contact plate under the car passes beneath the hook and holds it up. The current is taken into the car as the plate slides along under the live hook. Naturally, as the car passes along, the hook slides off from the end of the contact bar and drops back into place. To protect this hook, or contact piece proper, it is covered with an extension of the cylinder, so that, as far as the street is concerned, the surface is perfectly smooth, and one sees nothing but a small round cover in the center of each of these boxes. The contact hook is alive only when it is resting on the contact plate of the car. In regard to the permanence and reliability of this system, I can say nothing, as no trials have been made.

Is it not possible for some bright inventor to devise a scheme whereby the insulation of the live parts can be maintained? We now come to the third or overhead method. I have addressed to all of the electric street railroads throughout the country a circular letter, asking for certain detailed information. The results of my own experience, and the summation of the answers to these questions, I lay before you.

There are two general methods of operating the overhead system. One is by having a continuous trolley wire wherever the track runs, and the second is to have this trolley wire divided into sections. For towns and for suburban traffic, the former is almost invariably adopted and carried out. Practice would seem to indicate that but little trouble is experienced, and that there is practically no advantage in dividing the trolley wire into sections. In fact, a disadvantage, since you lose its conductive capacity.

The sectional trolley wire surely must be used for all city work. It would be practically impossible to operate in Boston without proper divisions. It is, however, almost impossible to originally fix all of these divisions once for all, as the topography of the city, the grades, location of power houses, routes, lines of traffic, etc., all have to be taken into consideration. It is bound to be a gradual growth to a large extent.

Obviously the methods of feeding the trolley wire vary with the method of arranging the trolley wire. With the first method mentioned (using a continuous trolley wire) the feeders are either extended from the station the entire length of the line, tapping into the line at intervals, or else separate feeders are run out from the station to certain predetermined distances, and there tapped into the trolley wire. When more than one feeder wire is needed in either case a repetition of the scheme is carried out from feeder wire to feeder wire. There is little to choose between the two methods. Both are good.

With the second method (the divided trolley wire) there are two ways of accomplishing the feeding. First, to extend a feeder the entire length of the line and tap into the center of each section of trolley wire; or second, to extend the feeder the entire length of the line and tap into both ends of each section. The advantages of the former are, that in time of trouble a man has to run to only one box to cut out a section, or the whole arrangement could be made automatic by putting a fuse or mechanical circuit breaker in the box. The disadvantage is that you lose the value of the trolley wire as a conducting medium, which in the case of hard drawn copper wire is considerable.

In the latter method (tapping into the section at each end) obviously a man has to go to each end of the section to entirely cut out that section, and two sets of automatic devices would have to be arranged to operate in case of trouble. You have, however, the advantage of utilizing the trolley wire as a conductor.

It is undeniably true that the question of feeder wires is one of great importance, and a difficult one to always economically solve for all conditions. The point, however, which the railroad corporations should watch above all others is, that they have enough. I have visited many roads where I found that the larger part of the trouble which they were complaining of lay in the fact that they did not have either sufficient trolley wire or track feeders. Railroad officials are very apt to object to feeders, because of, first, their cost, and second, the placing of so many wires overhead, which is liable to bring them in conflict with the municipalities and the public. The question of having a sufficient number of feeders underground for the track, is one which they can have no valid or reasonable excuse for. I strongly recommend as many ground plates as it is possible to have, not only at the station, but also along the line; brooks, bog land, water pipes, everything should be utilized for this ground circuit wherever possible. The plates can be made of sheet copper or iron, preferably the latter, and should have a superficial area of several hundred square feet. The wire connecting them to the track should be of sufficient size and very solidly attached to the plate and the rails. The continuous supplementary wire should, in all instances, be employed, and the rails bonded at least once. In no instance do I think it necessary or wise to place the track feeders overhead. If this plan is adopted and carried out, and proper connections are made between the rails, I do not think the railroad companies will ever have any trouble with loss of power on their ground circuits. Referring again to the overhead feeder system, I am strongly of the opinion that for large cities all feeders should be placed underground. The cities in which this underground work has been adopted, are Buffalo, Minneapolis and St. Paul.

I firmly believe that the trolley wire system is here to stay for many decades, and although I hope for a successful underground system, it may never come.

Out of the 400 and odd circulars I sent out, I succeeded in getting answers from 137 roads, operating 1,546 miles of trolley wire and 1,637 motor cars. Of this number 71 were Thomson-Houston and 66 Edison or miscellaneous.

As to the trolley wire: Of the 137 roads 99 were using copper wire, 26 silicon bronze wire, eight were using both, and two were using phosphor bronze. Of those using

copper, one used No. 000, five No. 00, three No. 1, two No. 2, one No. 5 hard drawn copper, one used No. 0 soft drawn copper, making 13 in all, and leaving 86 as the number using No. 0 hard drawn copper wire. Of the 28 using silicon bronze 16 used No. 4, six No. 2, one No. 3, and the five remaining roads had combinations of two or more sizes. Of the eight using both silicon bronze and hard drawn copper six prefer the latter. Out of all these 99 using copper not one dissents, but of the 28 using silicon bronze 11 advise copper. The proof is conclusively in favor of hard drawn copper wire and of the larger sizes, No. 0 B. & S. seeming to be the standard. In regard to the wearing, the universal testimony is that it is exceedingly slight. What wearing is observable is found to be at the switches or on the curves. Serious mistakes have been made in the past by using iron-flanged trolley wheels. These cut the trolley wire badly. Everything should be done to throw all the wear onto the trolley wheels. These are much less expensive than wire, and not so hazardous for the public if they give out.

From my own information and knowledge I can say that the life of the trolley wire is much longer than I had originally anticipated. The criterion is not the years that it has been up, but the number of times the trolley wheels have passed over it. It would seem that with the ordinary brass trolley wheel the wear was about .001 of an inch to the passage of 65,000 cars. This is at the rate of one in every six minutes, for 18 hours per day, for one year. With only this wear the life of the wire would certainly be twenty years, unless through some process of crystallization it became more brittle. I anticipate but very little trouble in this direction, but eternal vigilance is nevertheless necessary. The breaking of the trolley wire has been rare, the breaks occurring either at splices or switches, or were due to some extraneous cause, such as falling trees, telephone poles or the catching of the trolley pole. Forty-one roads have their trolley wires divided into sections, and consider it necessary and advisable. Analysis shows that these roads are in the largest cities or towns.

Regarding span wires, 49 report as using galvanized iron wire, 55 as galvanized steel, 20 as using galvanized iron cable and one as using copper wire. The sizes range from No. 0 to No. 14. Comparatively few breaks are reported and no casualities. My own experience has led me to adopt No. 4 B. & S. soft galvanized iron wire. Whenever a long span or a curve is to be constructed I have had two or more of these wires twisted together into a cable. I have found that a cable made of small wires is hard to join, and it rusts much more quickly. Avoid joints and use a ball fastener in attaching span wire to eyebolt. On the whole, however, I have concluded that iron is not the proper material to use in any shape. It will rust and then your structure is weak. Pursuing my investigations into this matter, nearly a year ago, I found that a certain special quality of silicon bronze wire was the best. Tests of this wire in comparison to iron showed the following results:

No. 1 silicon bronze, diameter, .200; breaking weight, 2,550; breaking weight per square inch, 81,800; elongation in six feet, .8 per cent.; twists in six feet, 37.4. Galvanized iron, diameter, .205; breaking weight, 1,720; breaking weight per square inch, 52,000; elongation in six feet, 7.8 per cent.; twists in six feet, 19.

I am aware that the price of this wire is five or six times as great as that of the iron wire, but as the total sum in either case per mile is small, I strongly recommend it. Some of this wire has been in service on the West End road in Boston for nearly a year. It certainly will never rust out. Guard wires are universally condemned, but are put up as a compulsory protection from existing evils.

The descriptions of the various feeder systems are so vague I will not attempt to describe them. The average distance to which power is transmitted on these roads is about three miles. The greatest is 10.7 miles on the Tacoma and Steilacoom Railway, Tacoma, Wash. There are many, however, operating from eight to ten miles from the station.

The average speed of all the roads is 8.7 miles per hour. The maximum is 30. The average grade is 6.7 per cent., and but 12 roads report as having none, or very small ones. The maximum grade is 18½ per cent., and this extends for 1,500 feet. The road suffering from such an infliction is in Amsterdam, N. Y. Thirteen roads report 10 per cent. or over. Nashville, Tenn., reports an 11½ per cent. grade for 1,300 feet, and Burlington, Ia., an 8½ per cent. for 1,500 feet, while Wilmington, Del., reports a 7½ per cent. for 3,000 feet.

The loads carried up these grades by two 15 horse-power motors are, to say the least, surprising. Amsterdam reports one motor car and 52 passengers. Nashville reports one motor car and 77 grown passengers. Burlington, one motor car and 75 passengers and Wilmington, Del., reports one motor car towing a disabled motor car. Several roads report as towing one car with both full of passengers up eight and even nine per cent. grades, but for short distances. Auburn, N. Y., reports as having towed five cars all loaded, with one motor car. The grades in this instance were slight. In all these instances unquestionably the motors were exerting power considerably beyond their rated capacity. Trains carrying 350 passengers have been moved by two 15 horse-power motors; 200 passengers is an every day occurrence. Surely this is approaching steam railroad practice.

Out of the total number of 137 roads heard from, only 32 report as having made any tests of either engines, dynamo or motors, and 53 upon the overhead work. Surely this is lamentable. There is nothing more essential to an electric railroad than a first-class voltmeter, ammeter, galvanometer, and, if possible, a wattmeter. Every railroad should be continually testing its circuits, station and cars for leak or grounds. By this means, and this means only, can they avoid trouble and consequent damage.

I am happy to state that not one road reports as killed or even seriously injured an employé or passenger by the electric current or falling trolley or span wire. Several report employés as receiving shocks, and one of a boy throwing a wire over the trolley wire and receiving the full potential of the current. None, however, were seriously injured. Several accidents are reported of collision and running over, but these cannot be entirely avoided and are inherent in any system.

I asked the opinion of the railroads as to the reliability, permanency and safety of the electric system. All but one report most emphatically in its praise. I regret very much that this one prefers horses.

There is not to my knowledge to-day a single railroad corporation owning and operating storage batteries solely for what there is in them, nor do I believe there ever will be.

There is universal praise and encomiums sounding on every side for the overhead system. 6,700 cars operated over 3,000 miles of track in the streets of full 300 of our towns and cities surely testify to its merits and value. Of this number of towns and cities fully one-third have absolutely no other means of transportation. What objections there are are purely sentimental grounds. Given a city with all wires underground, where would be the objection to iron poles and a single wire for each track? The rails themselves would be a thousand times more of a nuisance and dangerous. The benefits to come from its introduction are incalculable. The wonderful and marvellous development of the past is not to stop, but inevitably must continue. Electric railroading, city, town and suburban, is here for our upbuilding and natural prosperity as surely as steam railroading was fifty years ago. There are equally great opportunities for fame and fortune with this new agent as with the old.

Mr. Wm. Richardson moved that the report be entered in full on the minutes and that the thanks of the Association be tendered to the author. Carried.

Mr. Richardson inquired which road was referred to that had given up the use of electricity and reverted to the use of horses and mules.

Mr. Mansfield: I referred to a road in the State of California, one of the early roads in that State.

Mr. MacGregor, of Houston: I would like information upon one point, and that is the matter of guard wires. Mr. Mansfield rather passed over the subject, stating that the guard wires are an abomination; but they represent a legal responsibility, and I would like to ascertain what has been found effective and simple, and not a nuisance in the way of an obstruction in the street. Of course, additional wires are objectionable, but we must have them, and if he or any other gentleman can give me the information I will be glad to have it.

Mr. Mansfield: When there is only one trolley wire to protect, we extend two light wires, about No. 14 size, on each side of the trolley wires, and about 18 inches above it and from 12 to 18 inches on either side. We suspend the longitudinal wires running parallel with the trolley wire; it is insulated as perfectly as possible from the pole and from the trolley span wire, and the longitudinal or guard wires proper are also insulated as far as possible from the span wire. In the case of two trolley wires, the general practice, so far as I have observed, is to stretch three guard wires—two of them outside of the two trolley wires and one over the center—all insulated perfectly from the other wires.

Mr. MacGregor: Have you found any trouble from induction?

Mr. Mansfield: We have never had any trouble for the reason that they are insulated from the trolley wires.

Mr. MacGregor: What do you consider their value as a protection to life and property?

Mr. Mansfield: I think they amount to a great deal; they certainly do. I think it is necessary to put them up; and as long as you keep them perfectly insulated from the trolley wires and any extraneous wire which may fall, they will strike them instead of the trolley wire and will dangle in the street as a dead wire which may be removed.

Mr. MacGregor: Have your investigations led you to form an opinion as to the relative wear of the sliding and rolling contact trolley?

Mr. Mansfield: No, sir. I believe only one road used a sliding contact trolley, and I think that has been abandoned.

Mr. MacGregor: I live on the line of a road using the sliding contact.

Mr. Mansfield: I cannot say anything about the relative wear.

Mr. Bickford, of Salem: I do not agree with Mr. Mansfield on the size of his guard wire. No. 14 is too small, nothing short of No. 10 should be put up for a guard wire.

Mr. Ramsey, of Pittsburgh: I wish to ask Mr. Mansfield how long he considers a No. 14 guard wire to last without rusting, so that it will be liable to break, or the other gentleman how long a No. 10 will last in an atmosphere like Pittsburgh, for instance?

Mr. Mansfield: That is a troublesome question to answer. It might be several years.

Mr. Bickford: My idea in the use of a No. 10 wire is not so much a question of its life, as its additional strength in supporting falling wires, especially when loaded with sleet in Winter. On a portion of my lines I had fallen telephone and telegraph wires on my guard wires for a long distance and through it all we operated our cars without interruption by using No. 10 steel wire.

Mr. Littell, of Buffalo: I wish to ask the gentleman if he does not think it advisable to cut up his wire into sections of, say, 1,000 or 1,500 feet, and put in circuit breakers, so that if any wire does fall, the current will not be sent a great distance.

Mr. Mansfield: I would advise it; and it is done on many roads; the West End Road, of Boston, I believe, do it every 500 feet.

Mr. Littell: It is done in Buffalo.

Mr. Wasson, of Cleveland: Mr. McKinstry, who is manager of the telephone lines in Cleveland, informed me that his telephone wires in the center of the city did not last much over a year, sometimes a year and a half. In our span wires we used a galvanized steel wire, and at the end of a year and a half they were rusted to such an extent that we dare not tighten them up. We have chemical works and oil works in Cleveland, and we do not know whether or not it is due to the gases that come from these factories. I believe our road was the first to use the soft drawn copper wire for span wires. The reason for using this in preference to hard drawn wire, or silicon bronze, was due to the fact that silicon bronze when first made was very brittle; strong if pulled straight, but if it became kinked or nicked it would break like a pipe stem. We use a soft drawn No. 4 for it, the same as for the ground work; that has been up now over a year, and there has been no perceptable elongation or stretching or sagging. When the storage battery will enable us to take down the span wires we will have something for scrap; the steel for span wires will be worth little, apparently. The copper wire will not corrode, and the only objection I have ever heard to it was the initial expense, and the possibility of it stretching.

Mr. Richardson: I have had submitted to me a copper triangle—triangular tube, if I may so call it—intended to cover over the trolley wire and to guard it thoroughly from any interference with wires that might otherwise come in contact with it. I wish to ask the gentleman's judgment of that device.

Mr. Mansfield: I have looked into a great many methods of protecting the trolley wire outside of the stringing of additional wires, but I have not seen any which, in my judgment, would lead me to adopt it upon any road where my advice was asked.

The trouble is that most of these devices, if you can hold them in position over the trolley wire, will walk and twist, and unless they are made very large the trolley wire may swing to one side or the other; they entail heavy span wires and an additional strain upon the side of the poles for their support. In the Winter time the top of these devices will be covered with a large accumulation of ice and snow, which throws a greater weight upon the span wires and strain upon the side of the poles for their support; then, again, they are difficult to put in place and maintain in place. That is the result of my observation, and I do not think there is anything as good as what is generally accepted and used to-day.

On motion of Mr. Littell the session adjourned.

THURSDAY MORNING'S SESSION.

The meeting opened at 10.30 o'clock.

The first business was the appointing of the nominating committee to nominate officers for the ensuing year and select a place of meeting for 1892.

The president appointed as the committee: Messrs. Charles Cleminshaw, of Troy, N. Y.; Thomas C. Barr, of Newark, N. J.; Robert McCulloch, of St. Louis, Mo.; Murry A. Verner, of Pittsburgh, Pa.; C. Densmore Wyman, of New York; H. A. Everett, of Cleveland, Ohio, and T. J. Minary, of Louisville, Ky.

The chairman of the committee then requested that if the representatives of any company desired to extend an invitation to the Association to meet in their city they would kindly do so at this time.

Invitations were made on behalf of Rochester, N. Y.; Boston, Mass.; Cleveland, Ohio; Houston, Texas, and from Milwaukee, Wis., to meet in that city in 1893.

The president announced the next order of business to be the report of the committee on "Public and State Treatment of Corporations," by Hon. G. Hilton Scribner, of New York city. In Mr. Scribner's absence Mr. C. D. Wyman read the report.

On motion, the report was received, ordered on the minutes and a vote of thanks was passed to the author for the able paper he had presented.

The next business was the report of the committee on "The Independent Primary or Storage Battery System of Electric Motive Power," an abstract of the report being as follows:

The Independent Storage or Primary Battery System of Electric Motive Power.

BY KNIGHT NEFTEL.

Mr. President and Gentlemen: Owing to a variety of causes, the system which was assigned to me at the last convention to report on, has made less material progress in a commercial way than its competitors.

PRIMARY BATTERIES.

So far, primary batteries have been applied only to the operation of the smallest stationary motors. Their application in the near future to traction, may, I think, be entirely disregarded. Were it not a purely technical matter, it might be easily demonstrated with our knowledge of electrochemistry, that such an arrangement as an electric primary battery driving a car is an impossibility.

In view of the claims of certain inventors, I regret to be obliged to make so absolute a statement; but the results so far have produced nothing of value.

SECONDARY BATTERIES.

The application of secondary or storage batteries to electrical traction has been accomplished in a number of cities, with a varying amount of success.

Roads equipped by batteries have now been sufficiently long in operation to allow us to draw some conclusions as to the practical results obtained and what is possible in the near future.

The advantages which have been demonstrated on Madison avenue, in New York; Dubuque, Iowa, Washington, D. C., and elsewhere, may be summarized as follows:

First. The independent feature of the system. The cars independent of each other and are free from drawbacks of broken trolley wires; temporary stoppages at the power station; the grounding of one motor affecting other motors, and sudden and severe strains upon the machinery at the power station, such as frequently occur in direct systems; the absence of all street structures and repairs to the same, and the loss by grounds and leakages are also very considerable advantage, both as to economy and satisfactory operation.

Secondly. The comparatively small space required for the power station. Each car being provided with two or more sets of batteries, the same can be charged at a uniform rate without undue strain on the machinery of the power station, and as it can be done more rapidly than the discharge required for the operation of the motors, a less amount of general machinery is necessary for a given amount of work.

Another and important advantage of the system is the low pressure of the current used to supply the motors, and the consequent increased durability of the motor, and practically absolute safety to life from electrical shock.

It has been demonstrated also that the cars can be easily handled in the street; run at any desired speed, and reversed with far more safety to the armature of the motor than in the direct system. The increased weight requires simply more brake leverage.

The modern battery, improved in many of its details during the last year, is still an unknown quantity as to durability. There is the same doubt concerning this as there was at the time incandescent lamps were first introduced. At that time some phenomenal records were made by lamps grouped with other lamps. Similarly, some plates appeared to be almost indestructible, while others, made practically in the same manner, deteriorate within a very short time. It is, consequently, very difficult to exactly and fairly place a limit on the life of the positive plates as yet. Speaking simply from observation of a large number of plates of

various kinds, I am inclined to put the limit of about eight months, though it is claimed by some of the more prominent manufacturers, and undoubtedly it is true in special cases, that entire elements have lasted 10 months and even longer.

It must be remembered, however, that the jolting and handling to which these batteries are subjected in traction work increased the tendency to disintegrate, buckle and short circuit, and that the record for durability for this application can never be the same as for stationary work.

A serious inconvenience to the use of batteries in traction work is the necessary presence of the liquid in the jars. This causes the whole equipment to be somewhat cumbersome and, unless arranged with great care and with a variety of devices lately designed, a source of considerable annoyance.

The connections between the plates, which formerly gave so much trouble by breaking off, have been perfected so as to prevent this difficulty, and the shape of the jars has been designed to prevent the spilling of the acid while the car is running. The car seats are now practically hermetically sealed, so that the escaping gases are not offensive to the passengers.

The handling of the batteries is an exceedingly important consideration. Many devices have been invented to render this easy and cheap. I have witnessed the changing of batteries in a car, one set being taken out and a charged set replaced by four men in the short space of three minutes. This is accomplished by electrical elevators, which move the batteries opposite the car, and upon the platforms of which the discharged elements are again charged.

The general conclusions which the year's experience and progress have afforded us an opportunity to make, may be summarized as follows:

Storage battery cars are as yet applicable only to those roads which are practically level, where the direct system cannot be used and where cable traction cannot be used, and applicable to these roads only at about the same cost as horse traction.

I feel justified in making this statement in view of the guarantees which some of the more prominent manufacturers of batteries are willing to enter into, and which practically insure the customer against loss due to the deterioration of plates; leaving the question of the responsibility of the company the only one for him to look into.

On motion, the report was ordered placed on the minutes and filed.

Mr. E. A. Scott, of Philadelphia: I am the representative of the company that has put in two successful plants, in Dubuque, Iowa, and Washington, D. C. We are now operating them as a commercial success. The gentlemen connected with those roads, if they are here, can probably tell you better than I what the result has been. I have seen the changing of the plates done in Dubuque in about 30 seconds, so that the question whether a storage battery car will run 100 miles without recharging or 50 miles does not become a matter of importance.

Mr Cleminshaw: How many cars on the line in Washington?

Mr. Scott: Six, and nine in Dubuque.

Mr. Cleminshaw: How long have they been running?

Mr. Scott: Since the early part of May in Dubuque and about three months in Washington. On certain portions of the road in Washington they are making 15 miles an hour. If the experience of everybody connected with the cars is to be believed, they run regular on their time, as regular as any other system, whether electric, cable or horse. I noticed in the paper that was read this morning that the question of comparative economy in running is stated to be about that of horses. We believe, from what we know, that it is considerably less than horses, although we have no figures to show. We believe that in about one year it can be run in competition, so far as economy is concerned, with any overhead system.

Mr. Wrenn, after considerable further discussion, offered the following resolution:

Whereas, Practical information upon the character of engine that gives the best results in power plants for traction purposes would be of great benefit to the members of the Association, and as there is much doubt on the question, that may be removed by investigation into practical experience of different companies having established active plants,

Resolved, Therefore, that a committee of five be appointed, which shall include the president and secretary, whose duty it shall be to obtain all available information upon this subject and report thereon. And, in view of the fact that early information to the members of the Association will be of great value, said committee shall ascertain the information, make a report and mail two printed copies thereof to each member on or before the first day of February. 1892.

Mr. Littell, of Buffalo, then offered the following resolution:

Whereas, The American Street Railway Association having learned that the collection of the statistics of electrical railroads for the Eleventh United States Census has been transferred to the division of manufactures and placed in charge of Mr. Allen R. Foote, special agent for the collection of statistics of the electrical industries; and

Whereas, The development of electric railroad construction and operation is of such recent date that nearly three times as many such roads are now in operation as in the last census year; and

Whereas, Those interested in street railroads, in common with those in other branches of the electrical industries, regard a complete and accurate report by the United States government of all electrical statistics, and especially those pertaining to electric railroads, as of vital and far-reaching public importance:

Be it resolved,

1. That this Association approves of the action of the Superintendent of the Census in placing the collection of the statistics of electric railroads in the division of manufactures and in charge of Special Agent Allen R. Foote.

2. That it requests Superintendent Porter of the Census Bureau for the census year to collect and report the complete statistics for electrical railroads down to the date of publication, and thus give to them their highest degree of value.

3. That the executive committee be requested to take the necessary measures to secure ample provision and authority for a complete census of the electrical industries, and that they be requested to confer with Special Agent Mr. Allen R. Foote in reference to the same and the form of report.

THURSDAY AFTERNOON'S SESSION.

The secretary read a letter of regret from Willard A. Smith, chief superintendent of railway exhibits of the World's Columbian Exposition, who had arranged to be present and address the Convention on the subject of the street railway exhibit, stating his inability to be present.

On motion of Mr. Richardson, the matter was referred to the Special World's Fair Committee.

The president announced the next order of business to be the report of the committee on "Standards in Electric Railway Practice." The report was read by Mr. Crosby, as follows:

Standards in Electric Street Railway Practice.

ABSTRACT BY O. T. CROSBY.

The object of this paper is to present some suggestions concerning a standard rating for electrical machinery, standard dimensions for parts of car apparatus, standard nomenclature for methods and parts, and standard method of keeping accounts.

First, let us consider the rating of electrical machinery. Thus far it has been common to speak of a machine as 15 horse-power or 25 horse-power motor, with scarcely any further suggestion of conditions under which it is supposed to operate. It must be borne in mind that an electric motor, like any other machine—a man, for instance—is capable of performing work at widely varying rates and widely varying efficiencies, and with widely varying factors of safety with respect to indefinite continuance of such a rate of work.

There is at present no conventional uniformity in these matters. Any rating whatever, in my opinion, should require the machine to perform its rated work indefinitely and under any condition of atmospheric temperature. There is, of course, room for honest differences of opinion in regard to this point. It is well known that the maximum demands for power in street railway service are not those which last for a considerable length of time.

With one manufacturer it will mean 20 horse-power for half an hour when the atmospheric temperature is 90 degrees. With a more conservative manufacturer the machine of the same capacity may be given a rating of 15 or 16 horse-power, having in view that the machine shall be able to work at its normal capacity for an indefinite length of time.

Again, in stating that the machine is of 15 horse-power capacity, even if there be agreement concerning efficiency and durability, there might be disagreement of much importance in regard to speed at which its work can be performed by the motor.

If we state concerning a motor that it can develop so much horizontal effort at that speed, we at once have a pretty close approximation as to what load of a car and passengers it can handle at that speed, since we know that 25 pounds per ton is a fair approximation to the average traction coefficient. Suppose, then, we are told that a motor can produce a horizontal effort of 500 pounds at 10 miles an hour; it is then a quick inference that a car weighing 20 tons can be carried by such a motor at the rate of ten miles per hour on a level. We may then conveniently call this motor a "500x10." If we further desire to get an approximate idea of what it will cost to do this work with a particular motor, we should know something of its efficiency. This can be conveniently expressed by adding another dimension. Thus, say the motor is "500x10x60." The "60" indicates the efficiency percentage with which electrical energy from the line is transmitted into mechanical energy and horizontal effort applied to the car.

It would, of course, in any such rating, be assumed that the machine is working under a pressure of 450 volts, which is not far from that found on most of the lines throughout this country.

I think it useless to attempt any change in the rating of dynamos. Their work is so much more regular than the work of a motor that the present rating in horse-powers or watts seems to answer the purpose fairly well.

Second, I feel that the time has now come when some of the physical dimensions of electric cars may, with benefit to all, be standardized.

May we not at this stage of development have a standard axle diameter for cars of a given weight? Also standard key weights for gears? And, while there is some uncertainty in my mind on this point, may we not have a standard gearing?

Coming to trolley apparatus, we might have uniform poles, pole sockets and uniform diameter of pole at the butt; also uniform length of pole and uniform diameter of trolley wheel.

Third, in regard to standardizing nomenclature. Besides causing annoying repetition and much explanation between men really understanding very well the thing in question, this uncertainty of nomenclature may, at times, stand seriously in the way of the proper interpretation of written contracts or of orders received by dealers.

While the adoption of a set of definitions by this Association would, in no sense be binding, it would yet tend to make definite that which is now indefinite. As a basis upon which some further and better work in this direction should be done, I give herewith a table showing list of proposed terms, with various terms heretofore used as equivalents, and definitions properly limiting the proposed terms:

NOMENCLATURE OF ELECTRIC RAILWAY TERMS.

Generator.—(Generator, dynamo.) Machine in which the electric current is generated.

Motor.—(Motor.) Machine in which the electric current is transformed into mechanical power.

Frame.—(Frame.) Iron body of machine, including pole pieces and standards or side arms, if any, but not including base plates and bearings.

Standards.—(Standard bracket.) Supports of the bearings of generator.

Side Arms.—(Side arms, check pieces, armature bracket.) Supports of bearings of railway motors.

Pole Pieces.—(Pole pieces.) That part of frame from whose surface lines of force may pass directly to the armature.

Field Coil.—(Field coil, spool.) Coils of wire wound on frame in such a way that a current passing through these coils makes magnets of the frame and pole pieces.

Brush Holder.—Device for holding the brushes in contact with the commutator, including the insulation used in its support.

Rocker Arm.—(Yoke, rocker arm.) Device for holding brush holders in position on commutator while attaching it directly or indirectly to the frame.

Fuse.—(Fuse, fusible plug.) A metal device for opening circuit when the current becomes abnormally large, the soft metal being melted by a current of fixed quantity.

Switch.—A device for closing or opening a circuit at one or more points.

Rheostat.—(Resistance box, rheostat.) Wire or other material suitably protected and conveniently arranged to be introduced in more or less proportion into a circuit.

Trolley.—(Trolley contact bar.) A device used to transmit the electric current from the overhead wire to the cars, consisting usually of a

Trolley Wheel.—A small metal wheel making rolling contact with the overhead wire.

Trolley Fork.—Mechanically connecting trolley wheel to

Trolley Pole.—Supporting the trolley fork and wheel and resting in a socket, which is part of the

Trolley Base Frame.

Trolley Wire.—Wire from which the trolley wheel directly receives current.

Trolley Frog.—(Frog, overhead switch, trolley switch.) A device used to fasten or hold together the trolley wires at a point where the trolley wire branches, and to guide, ordinarily, automatically the trolley wheel along the wire over the track taken by the car.

Trolley Frog.—(Standard frog.) A frog designed for use at a point where two branch lines make equal convergent angles with the main line.

Right Hand Trolley Frog.—A trolley frog designed for use at a point where a branch trolley wire leaves the main line to the right in the going direction.

Three Way Trolley Frog.—A trolley frog for use at a point where the line branches in three directions.

Draw Bridge Cross Over.—A device permitting the easy passage of a trolley wheel from one to the other of two adjacent wires in a continuous direction.

Trolley Crossing.—(Crossing frog, cross over.) A device placed at the crossing of two trolley wires by which the trolley wheel running on one wire may cross the other; the device also holding the two trolley wires together.

Insulated Trolley Crossing.—A device placed at the crossing of two trolley wires, by which the two wires are insulated from each other and by which the trolley wheel running on one line may cross the other.

Hanger.—(Line insulator, line suspension, trolley insulator.) A device for supporting and insulating the trolley wire.

Straight Line Hanger.—The hanger used on a straight line and supported from a span wire, the strain on same being essentially vertical.

Single Curve Hanger.—The hanger supported by a lateral strain in one direction and, ordinarily, on single track curves, except at ends and the inside curve of double track.

Double Curve Hanger.—The hanger supported by lateral strain in opposite directions, used ordinarily at ends of both single and double curves and at intermediate points, and on double track curves.

Feeder Clamp.—Clamp with a device by which a feed wire may be connected to the trolley wire.

Feeder.—A wire, usually insulated, used for transmitting current from the power station to the mains or the trolley wire descent.

Mains.—Wires, usually insulated, serving for the distributing of current from the feeders to the trolley wire through tap wires.

Tap Wires.—Wires to convey current from feeders or mains at the pole to a near point of the trolley wire.

Trolley Section.—A length of one trolley wire with or without branches but continuous electrically.

Line Section.—A part of the overhead conducting system so insulated from other parts as to permit the supply of power to be separately controlled.

Section Box.—A box containing section switches and fuses used for control of a trolley section or line section.

At the conclusion of the report Mr. Crosby made the following motion: That a committee on standardizing of ratings, nomenclature, dimensions and accounts for electric street railways be appointed by the Association.

The motion was adopted, the committee to consist of seven members, including the president and secretary.

On motion of Mr. Henry, of Pittsburgh, the following resolution was adopted:

Resolved, That the thanks of the American Street Railway Association are due, and are hereby tendered, to the Boston Lines Committee, the Central Traffic Association, New York, New England Passenger Lines Committee, Southern Passenger Association and Trunk Lines Association, for their courtesy in allowing reduced rates of fare to those in attendance at the tenth annual meeting of the Association, held in the city of Pittsburgh.

Resolved, that the Association respectfully urges upon the Western Passenger Association that the same courtesy be extended to their Association that is allowed by the other traffic associations, in order that the concession of the steam railroads shall become co-extensive with the territory which includes our membership.

The committee on nominations reported in favor of the following officers for the year 1891–2:

For president, John G. Holmes, Pittsburgh, Pa.

First vice-president, Thomas H. M. Lean, New York, N. Y.

Second vice president, James B. Speed, Louisville, Ky.

Third vice-president, Albion E. Lang, Toledo, O.

Secretary and treasurer, Wm. J. Richardson, Brooklyn, N. Y.

Executive committee: Henry M. Watson, Buffalo, N. Y.; Lewis Perrine, Jr., Trenton, N. J.; W. Worth Bean, St. Joseph, Mich.; Murry A. Verner, Pittsburgh, Pa.; Thomas C. Penington, Chicago, Ill.

The committee also recommended Cleveland, O., as the place for the next meeting.

Messrs. Henry, of Pittsburgh, and Crosby, of Utica, were appointed tellers, and Mr. Kerper, of Cincinnati, was empowered to cast the ballot of the members for the gentlemen named.

The president declared the above gentlemen duly elected officers of the Association for the ensuing year.

There was a very earnest discussion on the subject of the place of the next meeting.

Mr. Stephenson, of Washington, strongly favored going to Boston, Mass. He said that as the Association had received an invitation to go to Milwaukee, in 1893, the object being to visit the World's Fair *en route*, he believed it would be only proper to go to Boston next year, 1892, as the custom of the Association had been to alternate between the East and West. Messrs. Kerper, of Cincinnati, and Eppley, of Orange, also supported the motion of Mr. Stephenson, believing that the Association should go to Boston.

Mr. Wm. Richardson said that as the committee had been authorized to select a place of meeting, it was proper to assume that they had considered the entire question, and no doubt had good reason for recommending Cleveland; and that unless some strong reason to the contrary was presented, he should uphold the committee in its recommendations, which he considered was the only fair course. Mr. Bean, of St. Joseph, and Mr. Cleminshaw, of Troy, were of the same opinion.

The roll was called and the result was largely in favor of Cleveland, O., where the next meeting will be held.

On motion of Mr. Wyman, the following resolution was adopted:

Resolved, That in accordance with the recommendation of the executive committee, as embodied in the report, the question of the next place of meeting was referred to the executive committee, whose duty it is to take under advisement the question of hotel accommodations and special rates, as an inducement for the Association to go to any certain city; and as soon as the selection is made the secretary be requested to notify the members of the selection made.

The chair appointed Messrs. Littell, of Buffalo, and Richardson, of Brooklyn, a committee to escort the newly-elected president to the chair.

Mr. Watson, the retiring president, presented Mr. Holmes to the Association, who said: Gentlemen of the American Street Railway Association, I thank you for the honor you have conferred upon me. I am not prepared to make a speech. I hope, however, I may be able to do as well as my worthy predecessor. If I succeed in doing that, I shall have accomplished a great deal. I thank you again for your kindness.

On motion the meeting adjourned.

A very enjoyable and largely attended banquet was held at the Monongahela House Thursday evening. The Mayor of Pittsburgh and other prominent city officials were present.

On Friday morning the delegates and all in attendance at the Convention, at 10.30, took the excursion steamer "Mayflower" and proceeded down the Monongahela and Ohio Rivers to the Davis Island Dam, a million dollar dam of the wicket pattern, just completed by the government, which contains the largest steamboat lock in the world. The boat then proceeded up the Monongahela as far as McKeesport, making short stops at the Continental Tube Works and the Edgar Thompson Steel Works. The Grand Army band of Pittsburgh furnished the music and lunch was served on board.

Electricity the Most Economical Power for Street Railways.

PREPARED FOR THE STREET RAILWAY CONVENTION BY THE EDISON GENERAL ELECTRIC COMPANY.

Although the electric street railway has a well recognized commercial existence of some four years, so far little has been known of its actual expense of operation, or its relative economy compared with other modes of street travel. It has been exceedingly difficult to secure sufficient data to be of value for purposes of comparison.

The data herewith presented concerning electric roads have been very carefully collected, and will enable accurate conclusions to be drawn respecting the relative merits of horses, cable and electricity as a motive power for street cars. If the capital available is limited to the amount necessary for the least expensive construction and equipment, this settles the question of choice of motive power.

Cost per car mile for cars of about equal carrying capacity seems to be at present the only basis of comparison. This expense, within the limits of traffic for which the power plant and equipment are adapted, remains pretty constant, regardless of variations in amount of traffic. Theoretically, the expense per car mile would slightly increase with an increase in traffic. In a general way, and without attempting to produce any proof in support of this opinion, it may be said that, other conditions remaining the same, the expense per car mile would increase about as the cube foot of the number of passengers carried.

Expense per car mile for an electric road depends chiefly upon cost of fuel, efficiency of steam and electric plant, wages, character of road as relates to grades and curves, and intelligent care of machinery, etc. With coal varying from $1 to $3.80 per ton, its consumption from 4.3 pounds to 12.2 pounds per car mile, a station output from 3.7 to 8.4, and even 10.7, electrical horse-power per car in operation, and wages of conductors and motor men from 10 to 20 cents per hour, the importance of these data is at once evident. Regarding care of machinery, a comparison may not be amiss. In the case of one road an average of one-sixth of the armatures in use go into the repair shop every month, generally because burned out. Another road using the same system, operating more cars upon heavier grades, has not had an armature burned out in nearly a year. As both do their own repairing, the manufacturing company is relieved of responsibility for this difference.

COMPARISON OF INVESTMENT AND OPERATING EXPENSES.

TABLE I.

	Total Investment Real Estate, Road and Equipment.		Car Miles Run Per Annum, Per Mile of Street Length.	Passengers Carried Annually Per Mile of Street Length.	Passengers Carried Per Car Mile Run.
	Per Mile of Street Length.	Per Mile of Track Length.			
22 Electric roads*	38,500	27,780	76,158	287,038	3.10
45 Horse roads†	33,406	31,093	43,345	251,816	5.81
10 Cable roads‡	350,325	184,275	309,395	1,355,965	4.38

TABLE II.

	Operating Expenses Per Car Mile Run. (Cents.)	Interest Charge Per Car Mile at Six Per Cent. on Total Investment. (Cents.)	Total of Operating Expenses and Interest Per Car Mile. (Cents.)	Cost Per Passenger Carried. Interest Excluded. (Cents.)	Cost Per Passenger Carried. Interest Included. (Cents.)
Electric roads	11.02	3.03	14.05	3.55	4.53
Horse roads	24.32	4.62	28.94	4.18	4.96
Cable roads	14.12	6.97	20.91	3.22	4.77

TABLE III.

	Ratio of Investment Per Mile of Street Length.	Ratio of Car Miles Run Annually Per Mile of Street Length.	Ratio of Cost of Operation Per Car Mile, Interest Included.	Proportional Traffic that Must be Done, Per Mile of Street Occupied, to Pay Operating Expenses and Six Per Cent. on the Investment.
Electric roads	1.152	1.757	.485	.852
Horse roads	1.000	1.000	1.000	1.000
Cable roads	10.486	7.138	.722	5.154

* Car miles run per annum, 14,013,187; passengers carried per annum, 43,614,972; street length, 184 miles; track length, 255 miles. † All the roads in Massachusetts operated exclusively by horses for 1885-90. Average for six years. ‡ From Census Bulletin, No. 55.

SEVEN REPRESENTATIVE ROADS, OPERATED ENTIRELY BY ELECTRICITY.

Road.	Length. Of all tracks.	Length. Of road.	Passengers carried annually per mile of road.	Number of cars in daily operation.	Average daily mileage per car.	Average number of passengers daily per car.	Passengers carried per car mile.	Operating expenses per mile.	Operating expenses per car per day.	Cost per passenger carried.
1	51.0	35.0	*162,857	50	100	313	3.13	12.29	12.29	3.93
2	40.0	19.5	487,582	140	91	188	2.06	7.80	7.10	3.79
3	16.0	10.0	199,000	16	125	343	2.75	8.43	10.54	3.07
4	8.5	5.0	*460,000	20	83	318	3.82	11.82	9.80	3.09
5	15.5	14.0	167,511	18	106	357	3.35	11.00	11.70	3.28
6	28.0	23.5	286,852	31	108	597	5.51	12.74	13.76	2.31
7	3.8	2.8	200,000	5	92	307	3.33	8.49	7.81	2.55
	162.8	109.8		280				9.83		3.28

* Estimated. Total annual car mileage, 9,862,000. Total number of passengers carried annually, 29,144,000.

Estimates upon track construction differ greatly, but the limit of profitable investment is not likely to exceed $10,000 per mile; while as fine and substantial a road-bed as electric car ever ran over was built at a cost, exclusive of paving, of about $5,000 per mile. The overhead structure need not cost to exceed $2,500 to $3,000 per mile of single track for best wood poles, or $3,500 to $5,000 for iron poles. For double track, iron poles, it would vary from $4,500 to $6,500 per mile, center pole construction being the cheaper and, in many other respects, preferable where it can be adopted; $3,000 to $3,500 per car is a liberal estimate for 16 feet to 20 feet cars, fully equipped, and the average is about two cars per mile of road. An allowance of 15 to 20 horse-power per car, at $80 to $100 per horse-power for station equipment, including steam plant, but not real estate or buildings, is very liberal. Thus we have, as an extremely liberal estimate, $26,000 per mile, exclusive of real estate, buildings and paving, for a road suitable for the heaviest metropolitan traffic. And it is a fact that a good and satisfactory road can be built and equipped for $20,000 per mile.

The following tabulated statement shows the comparative economy of the horse, cable and electric systems:

Table I shows that, taking street length as the unit of comparison, in the cases of roads under consideration, the total permanent investment of the electric roads is only 15 per cent. more than that of the horse roads, while the cable roads cost more than nine times as much as the electric roads. The average speed of cable and of electric cars is about the same, consequently the cable roads ran about four times as many cars per mile of street length as the electric. This would be expected, as the cable roads generally occupy the routes of heaviest travel. The horse roads ran more cars than the electric, for an equal length of road, but the latter having an advantage in higher speed, greatly exceed in car miles run. The electric roads carried fewest passengers per car mile, but carried nearly as many per mile of street occupied as the horse roads. On account of their more favorable location, the cable roads exceed both the others in passengers per mile of route. The column showing passengers carried per mile run gives a general idea of the relative number of passengers on a car at any one time.

Table II shows operating expenses per car mile, all taxes and fixed charges excluded, for each of the three systems; interest charge per car mile at six per cent. upon the total permanent investment; total of operating expenses and interest per car mile; cost per passenger carried, interest charge excluded, and the same with interest charge included. Upon every point, save the one unimportant one of cost per passenger carried (interest excluded), the superiority of the electric road is plainly evident.

Table III, for greater convenience in comparison, shows the ratios of the three most important items, and the proportional traffic that must be done, per mile of street occupied for each system, to pay operating expenses and six per cent. on the investment. Here, more than anywhere else, the superiority of the electric road is plainly evident, the last column showing that in but few cases can there be even a question as to which system offers the greatest inducement to the investor.

If the electric roads carried as many passengers per car mile run as the horse or cable roads, which they could easily do, and allowing for the increase in operating expenses due to increased traffic, the cost per passenger carried would be as follows:

At 5.81 passengers per car mile (number carried by horse roads), the cost would be, interest charge excluded, 2.38 cents.

At 5.81 passengers (as above), cost would be, interest charge included, 2.82 cents.

At 4.38 passengers per car mile (number carried by cable roads), the cost would be, interest charge excluded, 2.82 cents.

At 4.38 passengers (as above), cost would be, interest charge included, 3.51 cents.

This is not in any way an attempt to decry the cable system, as it is undeniable that it has a place of its own, where it is satisfactory to the public and profitable to the investors; but the claim is that, under all usual circumstances, the electric road can handle just as heavy traffic, as readily and satisfactorily to the public, with much greater economy in operation and much less investment of capital.

DETAILED DISTRIBUTION OF OPERATING EXPENSES.

For roads of 10 or 15 miles and upwards, operating 20 or more cars per day, averaging 105 to 110 miles each, grades moderate, a careful distribution of expenses, based upon the experience of the best roads, will *average* about as follows:

	Expenses per Car Mile. (Cents.)	
Maintenance of road-bed and track		.54
Maintenance of line		.12
Maintenance of power plant:		
Repairs on engines and boilers	.180	
Repairs on dynamos	.101	
Miscellaneous repairs	.078	.36
Cost of power:		
Fuel	.868	
Wages of engineers and firemen	.653	
Wages of dynamo tenders, etc	.220	
Oil, waste, water and other supplies	.218	1.96
Maintenance of rolling stock:		
Repairs on motors (ex. gearing)	.695	
Repairs on gearing and trolleys	.594	
Repairs on car bodies and trucks	.512	1.80
Transportation expenses:		
Wages of conductors and motor men	4.262	
Wages of starters, switchmen, track sweepers, etc	.268	
Cleaning and inspecting cars	.238	
Oil, waste and other supplies	.083	
Accidents to persons and property	.061	
Miscellaneous	.068	4.98
General expenses:		
Salaries of officers and clerks	.743	
Office expenses	.138	
Advertising and printing	.061	
Legal expenses	.068	
Insurance	.161	
Miscellaneous	.091	1.26
Total		11.02

HORSE SYSTEM.

Car mileage.—Total from April 1 to October 1, 1891, 136,933, on 4½ miles of track.

OPERATING EXPENSES.

	Ex. per Car Mile. (Cents.)
Maintenance of road-bed and track, based on experience of seven years, at $500 per mile per annum	1.059
Power, including feed, shoeing, repairs to harness, depreciation of horses, barn men, etc	9.141
Conductors and drivers	7.806
Other items, including washing cars, foremen, watchmen, starters, gas, water, coal, oil, etc	1.464
General officers, clerks, superintendents, etc., 20 per cent. of total amount	1.054
Legal expenses and damages, 20 per cent. as above	.202
Insurance	.179
All taxes and bridge tolls and rents	.980
Total of all operating expenses, taxes and tolls	21.975

NOTE.—In justice to the horse system it might be added that for the past two years the price of feed has been much above the general average.

COMPARATIVE SHOWING.

	Electric.	Horse.
Receipts per car mile	30.90	21.07
Operating expenses, taxes and tolls	14.92	21.98
Net earnings	15.38	

KINDRED INTERESTS

The Thomson-Van Depoele Electric Mining Company, Boston, have issued a handsome catalogue entitled "Electricity Applied to Mining Operations."

The Berlin Iron Bridge Company, of East Berlin, Conn., have received the contract for the new blacksmith shop building for the Dixon Manufacturing Company, of Scranton, Pa. Owing to the peculiar formation of the ground the building will be in the form of a letter L, and will be 60 feet wide by 235 feet long, constructed entirely of iron.

Okonite tubing seems to be fast replacing the soft rubber tubing for special insulating purposes. This is composed of a tough and almost indestructible compound and has all the high insulating qualities that the Okonite wires possess. It has a decided advantage over the ordinary soft rubber tubing, in that it is not in any way affected by exposure or by the action of the elements.

Messrs. Watson & Stillman, of New York, have recently added 5,000 feet to their already large hydraulic machinery works, thereby greatly facilitating the production of hydraulic tools. The output of hydraulic jacks and car wheel presses during the last two years has increased to such an extent that the adoption of this course was rendered absolutely necessary in order to keep abreast with their orders. From reports received as to the efficiency and superiority of this class of their manufactures, the prospect is decidedly encouraging.

The Wainwright Manufacturing Company of Massachusetts, has received the following regarding one of their well known feed water heaters:

Norwich, Conn., Sept. 23, 1891.

The Wainwright Manufacturing Company of Massachusetts, Boston, Mass:

Gentlemen: Your letter of the 18th inst. at hand. In reply will say your heater is giving as good if not better satisfaction than your agent represented it to us to do. It has never given us any trouble in any way. I would recommend the same to any one in want of a heater.

Very respectfully yours,
(Signed.) GEO. W. PHILLIPS, Supt.,
Norwich Electric Light Company.

The Electric Merchandise Company report for the last week sales of Burton electric heaters to the following roads: Spokane Electric Railway, Spokane, Wash.; Danville Electric Railway, Danville, Ill.; Stillwater Electric Railway, Stillwater, Minn.; Terre Haute Street Railway Company, Terre Haute, Ind.; Burlington Electric Railway, Burlington, Iowa; Reading Southwestern Railway, Reading, Pa.; Eau Claire Street Railway, Eau Claire, Wis.; People's Street Railway, Springfield, Ill.; Salt Lake Rapid Transit Company, Salt Lake City, Utah; Electrical Supply and Construction Company, Pittsburgh, Pa.; Minneapolis Street Railway Company, Minneapolis, Minn.; Pullman Palace Car Company, Pullman, Ill.; Windsor and Sandwich Railway, Windsor, Canada. Electric heating by the Burton company's process is a fully demonstrated success, and the great advantages of this method of heating are realized by managers of electric roads.

The Ball Engine Company, Erie Pa.—A 100 horse-power tandem compound engine is to furnish the power for the new electric road being built by the Beatrice Rapid Transit Company, Beatrice, Neb. The Ball Engine Company shipped the Buffalo Street Railway Company, a few days ago, a 300 horse-power cross compound engine, being the fourth of the same size built by them for the Buffalo Street Railway Company. J. W. Parker & Company, Philadelphia, Pa., representatives of the Ball Engine Company, are installing a 100 horse-power engine built by that company in the station of the Citizens' Electric Illuminating Company, Pittston, Pa. The California Electric Light Company, San Francisco, Cal., are adding to their already immense power plant a 300 horse-power cross compound Ball engine. W. F. & F. C. Sayles, Saylesville, R. I., are installing an isolated electric light plant. A 85 horse-power Ball engine supplies the necessary power. The Falconer Manufacturing Company, Falconer, N. Y., have purchased a 150 horse-power engine for running electric light plant and for operating their works.

WHAT WE CAN DO.

We can furnish you with Dynamos of the best System. We can also furnish you with Electric Construction of the finest quality, including supplies of all kinds. Our specialties: General Construction and Erection of Lighting Plants.

Address, W. L. POPPLE & CO.,
CONSULTING ELECTRICIANS
AND ELECTRICAL ENGINEERS,
407 The Rookery, CHICAGO.

LITTLE GIANT.
R. I. Telephone & Electric Co.,
Providence, R. I.

"A BIG HIT!"
AN ADJUSTABLE HAMMER
WE CLAIM this is the Best, Cheapest, Loudest Ringing and Handsomest Electric Bell in the United States.
WRITE FOR PRICES.
(Patent Applied For.)
HAY-HORN MFG. CO.,
63 South Canal Street,
NEW CATALOGUE READY. CHICAGO.
Eastern Agt., Jas. E. Mason, 120 Park Ave., B'klyn, N. Y.

THE REMINGTON
STANDARD
TYPEWRITER

Is to-day, as it has ever been, the leading Typewriter.
Carefully tested improvements are constantly added to this famous machine.
Send for Illustrated Catalogue.
Try Our Paragon Brand of Typewriter Ribbons
Wyckoff, Seamans & Benedict.
327 Broadway, New York.

PATENT PERFORATED
ELECTRIC
LEATHER BELTING
MANUFACTURED BY
Charles A. Schieren & Co.,
45, 47, 49, 51 FERRY ST.,
COR. CLIFF ST.
BRANCHES:
BOSTON, 119 HIGH STREET.
PHILADELPHIA, 226 NORTH 3d STREET.
CHICAGO, 46 SOUTH CANAL STREET.

IF YOU have anything pertaining to electric machinery you want to sell, send us the description.
IF YOU want anything pertaining to electric machinery, send us your inquiries.
FRANK RIDLON & CO.,
Dealers in New and Second-Hand
Electric Light & Power Machinery,
196 SUMMER STREET, BOSTON.

MACHINERY IN STOCK.

Engine Lathes, 10 in. x 4 ft.; 11 in. x 5 ft.; 13 in. x 6 ft.; 14 in. x 6 ft.; 16 in. x 6 ft.; 18 in. x 8 ft.; 20 in. x 8 ft., with tapes attachment; 22 in. x 12 ft. and 14 ft.; 24 in. and 26 in. x 16 ft.; 30 in. x 10 ft. and 18 ft.; 36 in. and 38 in. x 20 ft.; 42 in. x 12 ft.; 56 in. x 18 ft.; 72 in. x 20 ft.; 108 in. x 22 ft. Fox Lathes, 13 in. x 5 ft.; 14 in. x 5 ft.; 15 in. x 6 ft.; 18 in. x 6 ft. Turret Lathes, 12 in. x 5 ft.; 14 in. x 5 ft.; 15 in. and 16 in. x 6 ft.; 18 in. x 6 ft.; 36 in. x 8 ft.
Planers, 16 in. x 16 in. x 3 ft.; 20 in. x 20 in. x 4 ft.; 24 in. x 24 in. x 6 ft.; 30 in. x 30 in. x 6 ft.; 36 in. x 36 in. x 10 ft.; 42 in. x 42 in. x 12 ft.; 72 in. x 60 in. x 15 ft.; 72 in. x 60 in. x 20 ft.
Friction Shapers, 15 in., 16 in., 20 in., 22 in., 32 in.
Crank Shapers, 6 in., 8 in., 10 in., 12 in., 15 in., 16 in., 20 in., 24 in., 28 in.
Screw Machines, Nos. 1, 2, 3, 4, with or without Wire Feed.
Screw Machines, Nos. 5, 6, 7, 8, Power Feed.
Presses, Nos. 51, 52, 53, Ferracute, Nos. 1, 2, 3, Stiles & Parker.
20 Lincoln Pattern Millers, No. 2.
Hand Millers, Nos. 1 and 2. 3 Cam Cutters.
Bolt Cutters, ¼ in. to 1 in., ¼ in. to 2 in.
2 Profiling Machines. 1 36 in. and 48 in. Gear Cutter.
1 New Horizontal Boring Machine. Newark Machine Tool Co.
Send for List of New and Second-Hand Machinery in Stock.
PRENTISS TOOL & SUPPLY CO., P. O. Box 3362.
115 Liberty Street, New York.

THE LAW
Double Cylinder Battery.

Surface of negative element and quantity of solution double that found in any other open circuit cell.
Weigh carefully these advantages.

Its sale has steadily increased for ten years.
LAW TELEPHONE CO.,
Sole Makers,
87 JOHN STREET, NEW YORK.

THE ELECTRICAL ENGINEERING COMPANY,
Contractors for Complete Arc, Incandescent and ower Plants.
ROOM 603, MONON BLOCK, 320 DEARBORN ST., CHICAGO, ILL.
Superintending Electrical Construction, and Advice on Electrical and Mechanical Subjects a Specialty.

Standard Electrical Measuring Instruments.
We make a great variety of Testing Instruments, such as Ammeters, Voltmeters, Galvanometers, Resistance Boxes, Photometers—in fact, everything that an electrician requires in making measurements of current, E. M. F., resistance, insulation, efficiency, etc.
Correspond with us before placing your orders, and send for our illustrated catalogue No. 1-66.
QUEEN & CO., Makers, Philadelphia.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON OCTOBER 20, 1891.

461,293 Motor truck. 461,294 Automatic electric pump. 461,295 Electrically actuated pump.

461,297 Actuating device for moving commutator brushes; Charles J. Van Depoele, Lynn, Mass.

461,296 Armature for electric motors; Charles J. Van Depoele, Chicago, Ill.

461,298 Electric switch; Sterling P. Van Nort, St. Louis, Mo.

461,355 Electrical drop bar for doorways; Benjamin Lyons, Kansas City, Mo.

461,371 Fire alarm apparatus; William C. Shaffer, Milwaukee, Wis.

461,420 Spring cushioned or suspended arc lamp; Charles F. Brush, Cleveland, O., assignor to the Brush Electric Co., same place.

461,423 Electric clock winder; James W. Du Laney and Charles F. Du Laney, Canton, O.

461,494 Circuit closer for clock winding mechanism; James W. Du Laney, Canton, O.

461,457 Thermo-electric element; Charles W. Iden, New York, N. Y., assignor to the Thermo-Electric Co., of West Virginia.

461,452 Electric wire connector; Geo. R. Scrugham, Lexington, Ky.

461,456 Electric switch; Alfred Swan, Orange, N. J., assignor to the Insulite Manufacturing Co., New York, N. Y.

461,464 Non-interfering successive signaling system and apparatus; Frank B. Wood, New York, N. Y., assignor to Theodore W. Bayaud, same place.

461,467 Composition of matter for insulating purposes; Marcus O. Farrar and Charles C. Howe, Bristol, N. H.

461,470 461,473 461,474 Telautograph. 461,471 Art of telegraphy. 461,472 Art of and apparatus for telautographic communication; Elisha Gray, Highland Park, Ill.

461,493 Electric elevator; James E. Byrne, Boston, Mass.

461,495 Automatic switch for railroads; William H. Davis, Evansburg, O.

461,526 Adjustable transformer; Elihu Thomson, Lynn, Mass.

461,548 Contact plow for electric cars; Edward M. Bentley, Brooklyn, N. Y.

461,549 Conduit and conductor for electric railways; Walter H. Knight, New York, N. Y.

461,552 Field magnet for dynamo-electric machines; Frank J. Sprague, New York, N. Y., assignor to the Sprague Electric Railway and Motor Co.

461,554 Electrical valve controller. 461,555 Shunt magnet for valve controllers; John V. Stout, Easton, Pa.

461,560 Snap switch; Henry P. Ball, New York, N. Y., assignor to the Edison General Electric Co., same place.

461,561 Snap switch. 461,562 Electric wire connection. 461,563 Electrical connecting device; Henry P. Ball, Brooklyn, assignor to the Edison General Electric Co., New York, N. Y.

461,568 Coupler for electric wires; James H. Delany, South Orange, N. J., assignor to the Edison General Electric Co., New York, N. Y.

461,569 Arc lighting system; Robert S. Dobbie, Brooklyn, N. Y.

461,570 Thermal cut-out; Lorenzo B. Favor, Gloucester, Mass., assignor to the Thermal Electric Co., same place.

461,573 Telephone system; Claude C. Gould, Buffalo, assignor to the Eastern Electrical Manufacturing Co., Wheatfield, N. Y.

461,575 Electric meter; Albert B. Herrick, New York, N. Y.

461,582 Hanger for overhead wires; Charles A. Lieb, New York, N. Y., assignor to the Sprague Electric Railway and Motor Co., same place.

461,611 Trolley switch; Charles E. Hudson, Leominster, Mass., assignor to the Pierce Brothers & Co., same place.

461,631 Insulating support for electric conductors; Robert J. Hewett, St. Louis, Mo.

461,657 Control apparatus for the position of signal disks; Theodor Weisser, Vöhrenbach, Germany.

461,659 Electric arc lamp; Aloys Wirsching and Rupert Schaefbauer, New York, N. Y.

461,662 Motor truck for cars; George M. Brill, Philadelphia, Pa.

461,677 Electric Conduit; Edwin T. Greenfield, New York, N. Y., assignor to the Interior Conduit and Insulation Co., same place.

461,685 Electric railway; Frank Mansfield, New York, N. Y.

461,690 Electric railway; Sidney H. Short, Cleveland, O., assignor to the Short Electric Railway Co., same place.

461,706 Incandescent double key lamp socket; William J. McCutcheon, Jr., Pittsburgh, Pa.

461,748 Annunciator; Lambert F. Fouts, Trinity Mills, Tex.

461,760 Electric block signaling system; John La Burt, New York, assignor of one-half to William H. Agricola, Brooklyn, N. Y.

461,761 Electric switch; George R. Lean, Boston, Mass., assignor to the Bernstein Electric Co., Portland, Me.

461,770 Electric railway brake; Augustin I. Ambler, Washington, D. C., assignor to Roseline N. Ambler, same place.

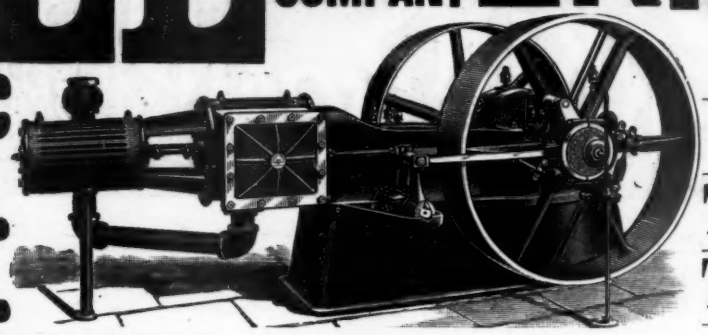
FOR SALE.

ONE 10 Horse-Power Self-Regulating Excelsior Motor for constant current (6½ amperes). In perfect condition, having been used but two months.

Address, J. B. W.,
THE ELECTRICAL REVIEW, NEW YORK.

BALL ENGINE COMPANY ERIE, PA.

AUTOMATIC CUT-OFF ENGINE



Standard.
Cross Compound.
Triple Expansion.
Tandem Compound

ENGINES for ELECTRIC RAILWAY and ELECTRIC LIGHTING.

The only GOVERNOR giving ABSOLUTELY the Same Speed under all CHANGES OF LOAD or BOILER PRESSURE.

SELLING AGENTS. E. T. COPELAND & CO., 106 Liberty St., New York; J. W. PARKER, 38 So. Fourth St., Philadelphia, Pa.; DRAVO & BLACK, 804 Lewis Block, Pittsburgh, Pa.; NORTHWESTERN SUPPLY CO., Tacoma, Wash.; BRANCH OFFICE, Room 506, The Rookery Building, Chicago, Ill., Albert Fisher, Manager.

THE ★ STAR VENTILATOR

MERCHANT & CO., PHILADELPHIA.

Send for our Book on Ventilation; also "A Tin Roof."

STUDY LAW AT HOME.

Take a Course in the Sprague Correspondence School of Law. Send ten cents (stamps) for particulars to

J. COTNER, Jr., Sec'y,
217 Whitney Block,
DETROIT, MICH.

HOW TO MANAGE AN
ELECTRIC LIGHT PLANT.
SEND FOR
MAY'S
POPULAR
INSTRUCTOR.

An indispensable hand-book for persons in charge of Electric Lighting Plants, more particularly those who have had little or no technical training.

66 PAGES. CLOTH. PRICE, $1.00

Electrical Review,
13 PARK ROW,
P. O. Box 3329. NEW YORK.

The Burton Electric Heater for Electric Railway Cars

NO SMOKE! NO GASES! EASILY MANAGED! ECONOMY IN SPACE!

Normal use of current, THREE AMPERES, and the cost of this is in the coal burned at the generating station, which is actually LESS than that of coal burned in a stove on a car.

"They are giving us and the public entire satisfaction."—RICHMOND, VA., U. P. RY. CO.
"The heat is pleasant, sufficient and economical."—MARLBOROUGH, MASS., STREET RY. CO.
"We are much pleased with them, and know of no reason why we shall not continue to use them and recommend them to others."—ST. LOUIS AND EAST ST. LOUIS ELECTRIC RY. CO.
"They give us good satisfaction, and our citizens are more than pleased with them."—HANNIBAL, MO., ELECTRIC RAILWAY CO.
"Your heaters have given satisfaction to our patrons as well as ourselves."—LYNN, MASS., BELT LINE STREET RAILWAY CO.

CHICAGO AGENTS, ELECTRIC MERCHANDISE CO., 11 ADAMS STREET.

For Further Information, Address,

THE BURTON ELECTRIC COMPANY, RICHMOND, VA.

Shultz Belting Company,
MANUFACTURERS OF
SHULTZ PATENT FULLED LEATHER BELTING AND LACE LEATHER
Office and Factory: Cor. Bismarck and Barton Sts., St. Louis, Mo.

Our Belting is made of leather tanned on the surface only; the interior (which is the fiber and strength of the hide) is not tanned but rawhide fulled and softened by our patent process. Our Belting is more pliable, hugs the pulley better, transmits more power than any other, and is the only perfect ELECTRIC LIGHT BELT MADE. Agents in all cities. Send for trial belt.

WRITE For the Electrical Review's *New Catalogue* of all Electrical and Scientific Books.
18 PARK ROW, NEW YORK.

THE ELECTRIC RAILWAY
OF
TO-DAY

BY H. B. PRINDLE.

FULLY ILLUSTRATED. **PRICE, 50 Cents.**

THE ELECTRIC RAILWAY IS TREATED IN A POPULAR MANNER, AND DESCRIBED IN SUCH LANGUAGE THAT THE READER WHO IS UNFAMILIAR WITH TECHNICAL TERMS CAN READILY UNDERSTAND THE CONSTRUCTION OF THE APPARATUS AND THE FUNCTIONS OF VARIOUS APPLIANCES USED IN THE ELECTRICAL PROPULSION OF STREET CARS.

THIS BOOK WILL BE SENT TO ANY ADDRESS ON RECEIPT OF PRICE.

ELECTRICAL REVIEW,

P. O. BOX 3329. 13 PARK ROW, NEW YORK.

THE PERKINS INCANDESCENT LAMPS.

CLAFLIN & KIMBALL Genl Agents 116 BEDFORD ST. BOSTON MASS.

NEW YORK—14 WHITEHALL ST. THE TUCKER ELECTRICAL CONS. CO.
PHILADELPHIA—806 WALNUT ST. O. D. PIERCE & CO.
CHICAGO—56 FRANKLIN ST. THE KNAPP ELECTRICAL WORKS.

UNIVERSAL ARC LAMPS.

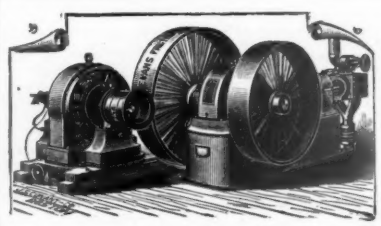
INCANDESCENT CIRCUITS.

2 in Series,
6 to 8 Amperes,
100 to 120 Volts,
14 Hour Carbons,
No External Resistance.
A Perfect Arc Lamp.

They will burn in this position.

For Central Stations, Isolated Plants and Electric Street Railways.

UNIVERSAL ARC LAMP CO.,
Office, 44 Broad Street, NEW YORK.

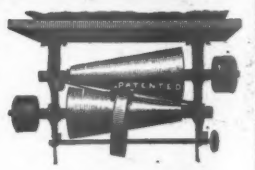


FOR DRIVING DYNAMOS.

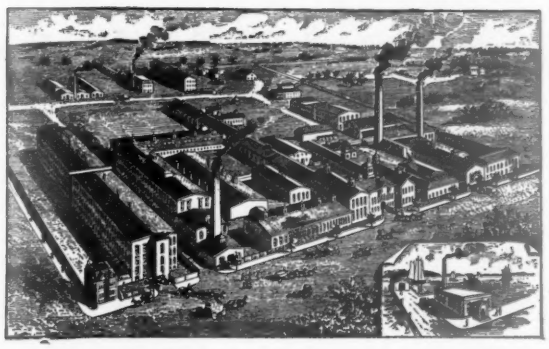
THOUSANDS OF HORSE-POWER IN USE DRIVING DYNAMOS, and HUNDREDS of sets of Speed Cones, driving all classes of machinery where variable speed is desired.

FOR INFORMATION IN REGARD TO APPLICATION TO DYNAMOS SEND FOR CATALOGUE H, AND IN REGARD TO CONES FOR CATALOGUE X, TO

EVANS FRICTION CONE CO., 85 Water St., Boston.



EVANS CONES FOR VARIABLE SPEED.



N. I. R.

NATIONAL INDIA RUBBER CO.,
Seamless Rubber Insulated Wires and Cables.
FACTORY AND OFFICES, BRISTOL, R. I.
SAMUEL P. COLT, Prest. and Treas. FREDERICK S. MINOTT, Gen'l Man.
SEND FOR CATALOGUE.

AN UNQUALIFIED SUCCESS.

FIRST GENUINE SUCCESS EVER MADE IN — THE GAS FIELD. —

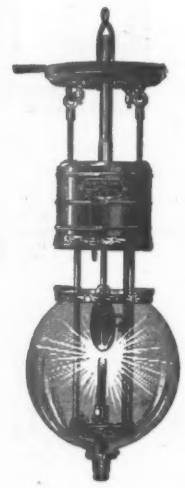
We do not send an apology with our Engines—"we do not have to"—but we have all the other improvements of our competitors.

AND AN ADDITIONAL ADVANTAGE.

The Rollason Gas Engine will run an electric dynamo superbly (show us another that will), giving a perfect light without a flicker; turn them on or off by the dozen at your will, it's all the same.

Send for our Catalogue No. 5, or, better, call at the warerooms and see three engines of different sizes in action.

ROLLASON GAS ENGINE,
134 Liberty Street, New York.



ALL-NIGHT ELECTRIC LIGHTING.

The "RUSSELL" is the only single carbon lamp on the market that will accomplish this purpose successfully and economically, burning 12, 18 and 24 hours with a single trimming.

Send for one of the "BABY RUSSELL" lamps. The handsomest and smallest arc lamp in the world.

Extreme length, 27 inches, and only 23 inches from hanger-board.

Foreign and domestic correspondence solicited.

WRITE FOR CIRCULAR No. 5.

RUSSELL ELECTRIC COMPANY,
85 Water Street, BOSTON, MASS., U. S. A.

AGENTS:

B. & S. Electric Equipment Co., 115 Broadway, New York, N. Y.
Illinois Electric Material Co., 156 Fifth Ave., Chicago, Ill.